B. STEELHEAD

B.1. BACKGROUND AND HISTORY OF LISTINGS

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Background

Steelhead is the name commonly applied to the anadromous form of the biological species *Oncorhynchus mykiss*. The present distribution of steelhead extends from Kamchatka in Asia, east to Alaska, and down to southern California (NMFS 1999), although the historical range of *O. mykiss* extended at least to the Mexico border (Busby et al. 1996). *O. mykiss* exhibit perhaps the most complex suite of life-history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident (and under some circumstances, apparently yield offspring of the opposite form). Those that are anadromous can spend up to 7 years in fresh water prior to smoltification, and then spend up to 3 years in salt water prior to first spawning. The half-pounder life-history type in Southern Oregon and Northern California spends only 2 to 4 months in salt water after smoltification, then returns to fresh water and outmigrates to sea again the following spring without spawning. This species can also spawn more than once (iteroparous), whereas all other species of *Oncorhynchus* except *O. clarki* spawn once and then die (semelparous). The anadromous form is under the jurisdiction of the National Marine Fisheries Service (NMFS), while the resident freshwater forms, usually called “rainbow” or “redband” trout, are under the jurisdiction of U. S. Fish and Wildlife Service (FWS).

Although no subspecies are currently recognized within any of the species of Pacific salmon, Behnke (1992) has proposed that two subspecies of *O. mykiss* with anadromous life history occur in North America: *O. mykiss irideus* (the “coastal” subspecies), which includes coastal populations from Alaska to California (including the Sacramento River), and *O. mykiss gairdneri* (the “inland” subspecies), which includes populations from the interior Columbia, Snake and Fraser Rivers. In the Columbia River, the boundary between the two subspecies occurs at approximately the Cascade Crest. A third subspecies of anadromous *O. mykiss* (*O. mykiss mykiss*) occurs in Kamchatka, and several other subspecies of *O. mykiss* are also recognized which only have resident forms (Behnke 1992).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity; since these *runs* are usually named for the season in which the peak occurs, some rivers may have runs known as winter, spring, summer, or fall steelhead. For example, large rivers, such as the Columbia, Rogue, and Klamath rivers, have migrating adult steelhead at all times of the year. There are local variations in the names used to identify the seasonal runs of steelhead; in Northern California, some biologists have retained the use of the terms spring and fall steelhead to describe what others would call summer steelhead.

Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry, and duration of spawning migration (Burgner et al.

1992). The *stream-maturing* type (summer steelhead in the Pacific Northwest and Northern California) enters fresh water in a sexually immature condition between May and October and requires several months to mature and spawn. The *ocean-maturing* type (winter steelhead in the Pacific Northwest and Northern California) enters fresh water between November and April with well-developed gonads and spawns shortly thereafter. In basins with both summer and winter steelhead runs, it appears that the summer run occurs where habitat is not fully utilized by the winter run or a seasonal hydrologic barrier, such as a waterfall, separates them. Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966, Roelofs 1983, Behnke 1992). Coastal streams are dominated by winter steelhead, whereas inland steelhead of the Columbia River Basin are almost exclusively summer steelhead. Winter steelhead may have been excluded from inland areas of the Columbia River Basin by Celilo Falls or by the considerable migration distance from the ocean. The Sacramento-San Joaquin River Basin may have historically had multiple runs of steelhead that probably included both ocean-maturing and stream-maturing stocks (CDFG 1995, McEwan and Jackson 1996). These steelhead are referred to as winter steelhead by the California Department of Fish and Game (CDFG); however, some biologists call them fall steelhead (Cramer et. al 1995). It is thought that hatchery practices and modifications in the hydrology of the basin caused by large-scale water diversions may have altered the migration timing of steelhead in this basin (D. McEwan, pers. comm.).

Inland steelhead of the Columbia River Basin, especially the Snake River Subbasin, are commonly referred to as either *A-run* or *B-run*. These designations are based on a bimodal migration of adult steelhead at Bonneville Dam (235 km from the mouth of the Columbia River) and differences in age (1- versus 2-ocean) and adult size observed among Snake River steelhead. It is unclear, however, if the life-history and body size differences observed upstream are correlated back to the groups forming the bimodal migration observed at Bonneville Dam. Furthermore, the relationship between patterns observed at the dams and the distribution of adults in spawning areas throughout the Snake River Basin is not well understood. A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River Basin and the inland Columbia River; B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers (IDFG 1994).

The *half-pounder* is an immature steelhead that returns to fresh water after only 2 to 4 months in the ocean, generally overwinters in fresh water, and then outmigrates again the following spring. Half-pounders are generally less than 400 mm and are reported only from the Rogue, Klamath, Mad, and Eel Rivers of Southern Oregon and Northern California (Snyder 1925, Kesner and Barnhart 1972, Everest 1973, Barnhart 1986); however, it has been suggested that as mature steelhead, these fish may only spawn in the Rogue and Klamath River Basins (Cramer et al. 1995). Various explanations for this unusual life history have been proposed, but there is still no consensus as to what, if any, advantage it affords to the steelhead of these rivers.

In May 1992, NMFS was petitioned by the Oregon Natural Resources Council (ONRC) and 10 co-petitioners to list Oregon's Illinois River winter steelhead (ONRC et al. 1992). NMFS concluded that Illinois River winter steelhead by themselves did not constitute an ESA "species" (Busby et al. 1993, NMFS 1993a). In February 1994, NMFS received a petition seeking protection under the Endangered Species Act (ESA) for 178 populations of steelhead (anadromous *O. mykiss*) in Washington, Idaho, Oregon, and California. At the time, NMFS was conducting a status review of coastal steelhead populations (*O. m. irideus*) in Washington, Oregon, and California. In response to the broader petition, NMFS expanded the ongoing status review to include inland steelhead (*O. m. gairdneri*) occurring east of the Cascade Mountains in Washington, Idaho, and Oregon.

In 1995, the steelhead Biological Review Team (BRT) met to review the biology and ecology of West Coast steelhead. After considering available information on steelhead genetics, phylogeny, and life history, freshwater ichthyogeography, and environmental features that may affect steelhead, the BRT identified 15 ESUs—12 coastal forms and three inland forms. After considering available information on population abundance and other risk factors, the BRT concluded that five steelhead ESUs (Central California Coast, South-Central California Coast, Southern California, Central Valley, and Upper Columbia River) were presently in danger of extinction, five steelhead ESUs (Lower Columbia River, Oregon Coast, Klamath Mountains Province, Northern California, and Snake River Basin) were likely to become endangered in the foreseeable future, four steelhead ESUs (Puget Sound, Olympic Peninsula, Southwest Washington, and Upper Willamette River) were not presently in significant danger of becoming extinct or endangered, although individual stocks within these ESUs may be at risk, and one steelhead ESU (Middle Columbia River) was not presently in danger of extinction but the BRT was unable to reach a conclusion as to its risk of becoming endangered in the foreseeable future.

Of the 15 steelhead ESUs identified by NMFS, five are not listed under the ESA: Southwest Washington, Olympic Peninsula, and Puget Sound (Federal Register, Vol. 61, No. 155, August 9, 1996, p. 41558), Oregon Coast (Federal Register, Vol. 63, No. 53, March 19, 1998, p. 13347), and Klamath Mountain Province (Federal Register, Vol. 66, No. 65, April 4, 2001, p. 17845); eight are listed as threatened: Snake River Basin, Central California Coast and South-Central California Coast (Federal Register, Vol. 62, No. 159, August 18, 1997, p. 43937), Lower Columbia River, California Central Valley (Federal Register, Vol. 63, No. 53, March 19, 1998, p. 13347), Upper Willamette River, Middle Columbia River (Federal Register, Vol. 64, No. 57, March 25, 1999, p. 14517), and Northern California (Federal Register, Vol. 65, No. 110, June 7, 2000, p.36074), and two are listed as endangered: Upper Columbia River and Southern California (Federal Register, Vol. 62, No. 159, August 18, 1997, p. 43937).

The West Coast steelhead BRT[1] met in January, March, and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs. This report summarizes new information and the preliminary BRT conclusions on the following ESUs: Snake River Basin, Upper Columbia River, Middle Columbia River, Lower Columbia River, Upper Willamette River, Northern California, Central California Coast, South-Central California Coast, Southern California, and California Central Valley.

[1] The biological review team (BRT) for the updated status review for West Coast steelhead included, from the NMFS Northwest Fisheries Science Center: Thomas Cooney, Dr. Robert Iwamoto, Gene Matthews, Dr. Paul McElhany, Dr. James Myers, Dr. Mary Ruckelshaus, Dr. Thomas Wainwright, Dr. Robin Waples, and Dr. John Williams; from NMFS Southwest Fisheries Science Center: Dr. Peter Adams, Dr. Eric Bjorkstedt, Dr. David Boughton, Dr. John Carlos Garza, Dr. Steve Lindley, and Dr. Brian Spence; from the U.S. Fish and Wildlife Service, Abernathy, WA: Dr. Donald Campton; and from the USGS Biological Resources Division, Seattle: Dr. Reginald Reisenbichler.

Resident fish

As mentioned earlier, *O. mykiss* exhibits varying degrees of anadromy. Non-anadromous forms are usually called rainbow trout; however, nonanadromous inland *O. mykiss* are often called Columbia River redband trout. A form that occurs in the upper Sacramento River is called Sacramento redband trout. Although the anadromous and nonanadromous forms have long been taxonomically classified within the same species, the exact relationship between the forms in any given area is not well understood. In coastal populations, it is unusual for the two forms to co-occur; they are usually separated by a natural or man-made migration barrier. Co-occurrence of the two forms in inland populations appears to be more frequent. Where they co-occur, "it is possible that offspring of resident fish may migrate to the sea, and offspring of steelhead may remain in streams as resident fish" (Burgner et al. 1992, p. 6; Shapovalov and Taft 1954). Mullan et al. (1992) found evidence that in very cold streams, juvenile steelhead had difficulty attaining mean threshold size for smoltification and concluded that most fish in the Methow River in Washington that did not emigrate downstream early in life were thermally-fated to a resident life history regardless of whether they were the progeny of anadromous or resident parents. Additionally, Shapovalov and Taft (1954) reported evidence of *O. mykiss* maturing in fresh water and spawning prior to their first ocean migration; this life-history variation has also been found in cutthroat trout (*O. clarki*) and some male chinook salmon (*O. tshawytscha*).

As part of this status review update process, a concerted effort was made to collect biological information for resident populations of *O. mykiss*. Information from listed ESUs in Washington, Oregon, and Idaho is contained in a draft report by Kostow (2003) and summarized in Appendix B.5.1; relevant information for specific ESUs is presented in subsequent sections. Information about resident *O. mykiss* populations in California is summarized in Appendix B.5.2.

The BRT had to consider in more general terms how to conduct an overall risk assessment for an ESU that includes both resident and anadromous populations, particularly when the resident individuals may outnumber the anadromous ones but their biological relationship was unclear or unknown. Some guidance is found in Waples (1991), which outlines the scientific basis for the NMFS ESU policy. That paper suggested that an ESU that contains both forms could be listed based on a threat to only one of the life-history traits “if the trait were genetically based and loss of the trait would compromise the ‘distinctiveness’ of the population” (p. 16). That is, if anadromy were considered important in defining the distinctiveness of the ESU, loss of that trait would be a serious ESA concern. In discussing this issue, the NMFS ESU policy (Federal Register 56:58612; 20 November 1991) affirmed the importance of considering the genetic basis of life-history traits such as anadromy, and recognized the relevance of a question posed by one commenter: “What is the likelihood of the nonanadromous form giving rise to the anadromous form after the latter has gone locally extinct?”

The BRT also discussed another important consideration, which is the role anadromous populations play in providing connectivity and linkages among different spawning populations within an ESU. An ESU in which all anadromous populations had been lost and the remaining resident populations were fragmented and isolated would have a very different future evolutionary trajectory than one in which all populations remained linked genetically and ecologically by anadromous forms. Furthermore, in many (if not all) *O. mykiss* ESUs, the geographic area utilized by anadromous (but not resident) fish may represent a "significant portion of the range" of the ESA species, especially if the area encompassed by the marine migration is considered.

In spite of concerted efforts to collect and synthesize available information on resident forms of *O. mykiss*, existing data are very sparse, particularly regarding interactions between resident and anadromous forms (Kostow 2003). The BRT was frustrated by the difficulties of considering complex questions involving the relationship between resident and anadromous forms, given this paucity of key information. To help focus this issue, the BRT considered a hypothetical scenario that has varying degrees of relevance to individual steelhead ESUs. In this scenario, the once-abundant and widespread anadromous life history is extinct or nearly so, but relatively healthy native populations of resident fish remain in many geographic areas. The question considered by the BRT was the following: Under what circumstances would you conclude that such an ESU was not in danger of extinction or likely to become endangered? The BRT identified the required conditions as:

1) The resident forms are capable of maintaining connectivity among populations to the extent that historical evolutionary processes of the ESU are not seriously disrupted;
2) The anadromous life history is not permanently lost from the ESU but can be regenerated from the resident forms.

Regarding the first criterion, although some resident forms of salmonids are known to migrate considerable distances in freshwater, extensive river migrations have not been demonstrated to be an important behavior for resident *O. mykiss*, except in rather specialized circumstances (e.g., forms that migrate from a stream to a large lake or reservoir as a surrogate for the ocean). Therefore, the BRT felt that loss of the anadromous form would, in most cases, substantially change the character and future evolutionary potential of steelhead ESUs. Regarding the second criterion, it is well established that resident forms of *O. mykiss* can occasionally produce anadromous migrants, and vice versa (Mullan et al. 1992, Zimmerman and Reeves 2000, Kostow 2003), just as has been shown for other salmonid species (e. g., *O. nerka,* Foerster 1947, Fulton and Pearson 1981, Kaeriyama et al. 1992; coastal cutthroat trout *O. clarki clarki,* Griswold 1996, Johnson et al. 1999; brown trout *Salmo trutta,* Jonsson 1985; and Arctic char *Salvelinus alpinus*, Nordeng 1983). However, available information indicates that the incidence of these occurrences is relatively rare, and there is even less empirical evidence that, once lost, a self-sustaining anadromous run can be regenerated from a resident salmonid population. Although this must have occurred during the evolutionary history of *O. mykiss,* the BRT found no reason to believe that such an event would occur with any frequency or within a specified time period. This would be particularly true if the conditions that promote and support the anadromous life history continue to deteriorate. In this case, the expectation would be that natural selection would gradually eliminate the migratory or anadromous trait from the population, as individuals inheriting a tendency for anadromy migrate out of the population but do not survive to return as adults and pass on their genes to subsequent generations.

Given the above considerations, the BRT focused primarily on information for anadromous populations in the risk assessments for steelhead ESUs. This was particularly true with respect to Case 3 resident fish populations, the vast majority of which are of uncertain ESU status. However, as discussed below in the “BRT Conclusions” section, the presence of relatively numerous, native resident fish was considered to be a mitigating risk factor for some ESUs**.**

B.2.1. SNAKE RIVER BASIN STEELHEAD ESU

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The Snake River steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southwest Washington, eastern Oregon and north/central Idaho (NMFS, 1996). Snake River steelhead migrate a substantial distance from the ocean (up to 1,500 km) and use high elevation tributaries (typically 1,000-2,000 m above sea level) for spawning and juvenile rearing. Snake River steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs. Snake River basin steelhead are generally classified as summer run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify up-river summer steelhead runs into to groups based primarily on ocean age and adult size upon return to the Columbia River. A-run steelhead are predominately age-1 ocean fish while B-run steelhead are larger, predominated by age-2 ocean fish.

With the exception of the Tucannon River and some small tributaries to the mainstem Snake River, the tributary habitat used by Snake River steelhead ESU is above Lower Granite Dam. Major groupings of populations and/or subpopulations can be found in 1) the Grande Ronde River system; 2) the Imnaha River drainage; 3) the Clearwater River drainages; 4) the South Fork Salmon River; 5) the smaller mainstem tributaries before the confluence of the mainstem; 6) the Middle Fork salmon production areas, 7) the Lemhi and Pahsimeroi valley production areas and 8) upper Salmon River tributaries.

Resident *O. mykiss* are believed to be present in many of the drainages utilized by Snake River steelhead. Very little is known about interactions between co-occurring resident and anadromous forms within this ESU. The following review of abundance and trend information focuses on information directly related to the anadromous form.

Historical Returns

Although direct historical estimates of production from the Snake basin are not available, the basin is believed to have supported more than half of the total steelhead production from the Columbia basin (Mallet 1974). There are some historical estimates of returns to portions of the drainage. Lewiston Dam, constructed on the lower Clearwater, began operation in 1927. Counts of steelhead passing through the adult fish ladder at the dam reached 40-60,000 in the early 1960s (Cichosz et al. 2001). Based on relative drainage areas, the Salmon River basin likely supported substantial production as well. In the early 1960s, returns to the Grande Ronde River and the Imnaha River may have exceeded 15,000 and 4,000 steelhead per year, respectively (ODFW 1991). Extrapolations from tag/recapture data indicate that the natural steelhead return to the Tucannon River may have exceeded 3,000 adults in the mid-1950s (WDF 1991).

B.2.1.1. Summary of Previous BRT Conclusions

The primary concern regarding Snake River steelhead identified in the 1998 status review was a sharp decline in natural stock returns beginning in the mid-1980s. Of 13 trend indicators at that time, nine were in decline and four were increasing. In addition, Idaho Department of Fish and Game parr survey data indicated declines for both A and B run steelhead in wild and natural stock areas. The high proportion of hatchery fish in the run was also identified as a concern, particularly because of the lack of information on the actual contribution of hatchery fish to natural spawning. The review recognized that some wild spawning areas have relatively little hatchery spawning influence (Selway River, lower Clearwater River, the Middle and South forks of the Salmon River and the lower Salmon River). In other areas, such as the upper Salmon River, there is likely little or no natural production of locally native steelhead. The review identified threats to genetic integrity from past and present hatchery practices as a concern. Concern for the North Fork Clearwater stock was also identified. That stock is currently maintained through the Dworshak Hatchery program but cut off from access to its native tributary by Dworshak Dam. The 1998 review also highlighted concerns for widespread habitat degradation and flow impairment throughout the Snake basin as well as for the substantial modification of the seaward migration corridor by hydroelectric power development on the Snake and Columbia mainstem.

Previous Abundance

Although direct historical estimates of production from the Snake basin are not available, the basin is believed to have supported more than half of the total steelhead production from the Columbia basin (Mallet 1974). There are some historical estimates of returns to portions of the drainage. Lewiston Dam, constructed on the lower Clearwater, began operation in 1927. Counts of steelhead passing through the adult fish ladder at the dam reached 40-60,000 in the early 1960s (Cichosz et al. 2001). Based on relative drainage areas, the Salmon River basin likely supported substantial production as well. In the early 1960s, returns to the Grande Ronde River and the Imnaha River may have exceeded 15,000 and 4,000 steelhead per year, respectively (ODFW 1991). Extrapolations from tag/recapture data indicate that the natural steelhead return to the Tucannon River may have exceeded 3,000 adults in the mid-1950s (WDF 1991).

The previous status review noted that the aggregate trend in abundance as measured by ladder counts at the upper most Snake River dam (Lower Granite Dam since 1972) has been upward since the mid-1970s while the aggregate return of naturally produced steelhead was downward for the same period (Table B.2.1.1). The decline in natural production was especially pronounced in the later years in the series.

Table B.2.1.1. Summary of abundance and trend estimates for Snake River Steelhead ESU. Interim delisting target levels are explained in text. Estimates from previous status review in brackets.

Population(s)	5-year mean % natural origin	Recent Five-Year Geometric Mean			Short-term Trend (%/yr)		Interim Target	Current vs. Target
		Total	Natural					
		Mean (Range)	Current	Previous	Current	Previous		
Tucannon **	26 [44]	407 (257 – 628)	106	140	-3.7	-18.3	1,300	8%
Lower Granite Run*	14	106,175 (70,721- 259,145)	14,864	9,500	+6.1	+6.9	52,100	29%
Snake A run*	15	87,842 (50,974 – 25,950)	12,667		+8.5			
Snake B run*	11	17,305 (9,736– 33,195)	1,890		-0.6			
Asotin Cr++	?	87 Exp. Redds (0 – 543)		200	+4.0	-19.7	500	
Upper Grande Ronde+	77	1.54 RPM (0.3 – 4.7)			-2.9			
Joseph Cr	100^	1,542 (1,077 – 2,385)	1,542		+5.0		1,400	110%
Imnaha+	80	3.7 RPM (2.0 – 6.8)			-3.7			
Camp Creek	100^	155 (55 – 307)	155	80	+2.0	+1.7		

* 5-year geometric mean calculated using years 1997–2001
** 5-year geometric mean calculated using years 1999–2001
\+ 5-year geometric mean calculated using years 1996–2000
++ 5-year geometric mean calculated using years 1998–2001
^ Assumed, no hatchery releases into basin

B.2.1.2. New Data and Updated Analyses

Estimates of annual returns to specific production areas are not available for most of the Snake River ESU. Estimates are available for two tributaries below Lower Granite Dam (Tucannon and Asotin Creek). Annual ladder counts at Lower Granite Dam and associated sampling information allows for an estimate of the aggregate returns to the Snake River basin. In addition, area specific estimates are available for the Imnaha River and two major sections of the Grande Ronde River system. Updated estimates of return levels are summarized in Table B.2.1.1. Returns to Lower Granite Dam remained at relatively low levels through the 1990s; the 2001 run size at Lower Granite Dam was substantially higher relative to the 1990s. The recent geometric mean abundance was down for the Tucannon River relative to the last BRT status review. Returns to the Imnaha River and to the Grande Ronde River survey areas were generally higher relative to the early 1990s.

Overall, long-term trends remained negative for four of the nine available series (including aggregate measures and specific production area estimates; Figure B.2.1.7). Short-term trends improved relative to the period analyzed for the previous status review. The median short-term trend was +2.0% for the 1990-2001 period. Five out of the nine data sets showed a positive trend (Figure B.2.1.8).

IDFG has provided updated analyses of parr density survey results through 1999. IDFG concluded that "generational parr density trends, which are analogous to spawner to spawner survivorship, indicate that Idaho spring-summer chinook and steelhead with and without hatchery influence failed to meet replacement for most generations competed since 1985 (IDFG 2002). These data do not reflect the influence of increased returns in 2001 and 2002.

Population growth rate (λ) estimates for Snake River steelhead production areas (Table B.2.1.2, Figures B.2.1.6, B.2.1.7) demonstrate a similar pattern when compared to the simple trend analysis described above. The median long-term λ estimate across the nine series was 0.998 assuming that natural returns are produced only from natural-origin spawners and 0.733 if both hatchery and wild potential spawners are assumed to have contributed to production at the same rate-. Short-term λ estimates are higher, 1.013, assuming a hatchery effectiveness of 0, and .753, assuming hatchery and wild fish contribute to natural production in proportion to their numbers. These values are consistent with another recent analysis of population growth rates (McClure et al. 2003), which estimated λ at the ESU-level as 0.96 if hatchery fish do not reproduce, and 0.73 if they reproduce at a rate equal to that of wild fish. This analysis spanned the time period from 1980-2000, making it clear that the most recent returns have had an influence on lambda estimates, particularly in the short-term. [Note that population growth rate calculations in the Biological Opinion on the Federal Columbia River Power System (NMFS 2000) used assumptions of hatchery fish effectiveness bracketed by those in McClure et al. 2003.]

The standarized abundance trend and population growth rate estimates provided in this report do not explicitly differentiate potential density dependent effects from density independent survival effects. Abundance levels for many of the production areas considered in the analyses varied over a wide range. In several cases, it is likely that abundance, at least in some years, could be high enough to affect survival through density dependent mechanisms. To provide perspective on the potential for density dependent influences, recent geometric mean spawner abundance estimates are contrasted with interim delisting levels provided by NOAA fisheries regional office (http://www.nwr.noaa.gov/occd/InterimTargets.html). Interim delisting levels for Snake River spring/summer chinook production units were derived from recommendations of the Bevan Recovery Team. Interim delisting levels for upper Columbia spring chinook and steelhead were from Ford et al. (2001). The method described in Ford et al. (2001) was used to develop interim delisting levels for Mid-Columbia and Snake River steelhead production areas. The approach uses estimates of habitat area and, where available, estimates of spawning escapements during historical periods of high, sustained returns.

Table B.2.1.2 Snake River Steelhead. Population growth rate analysis. Summary of available trend data sets, results of calculating annual population growth rates (λ: geomean, probability geomean less than 1.0) Long-term = the length of the available data series, Short term = 1990 -2001 or most recent year. Population growth rates calculated for two hatchery effectiveness (HF) assumptions; HF = 0.0 hatchery fish available to spawn do not contribute to natural production, HF = 1.0 hatchery returns available to spawn contribute to broodyear natural production at the same rate as natural-origin spawners. Methods: DC – Dam counts; RC – redd counts; RPM – redds per mile index; TLC – estimated total live fish on spawning grounds, N/A – not available.

Snake River Steelhead	**Series Length**	**Method**	**% wild 1987-1996**	**% wild 1997-2001**	**1997-2001 geomean**	**HF**	**Long-term λ**	**Prob. λ<1**	**Short-term λ**	**Prob. λ<1**
Lower Granite Dam - Aggregate	1990-2001	DC	0.18	0.14	14,768	0 1	0.994 0.703	0.551 1.000	1.051 0.687	0.297 0.999
Lower Granite Dam – A run	1985-2001	DC	0.18	0.15	12,666	0 1	0.998 0.674	0.512 1.000	1.078 0.692	0.215 0.999
Lower Granite Dam - B run	1985-2001	DC	0.18	0.11	1,890	0 1	0.927 0.655	0.915 1.000	0.941 0.646	0.782 1.000
Tucannon River	1987-2001	DC	0.39	0.26	95	0 1	0.886 0.733	0.998 0.998	0.924 0.712	0.895 0.988
Grand Ronde River - Upper	1967-2000	RPM	0.83	0.77	N/A	0 1	0.967 0.951	0.668 0.736	1.013 0.958	0.436 0.705
Grand Ronde River - Joseph Creek	1974-2002	TLC	1.00	1.00	1,542	N/A	1.069	0.130	1.018	0.418
Imnaha River	1974-2000	RPM	0.80	0.80	N/A	0 1	1.042 1.026	0.242 0.534	0.929 0.899	0.873 0.927
Imnaha River - Camp Creek	1974-2002	TLC	1.00	1.00	154	N/A	1.077	0.099	1.007	0.460
Imnaha River - Little Sheep Creek	1985-2002	TLC	0.30	0.14	42	0 1	1.045 0.718	0.323 0.998	1.082 0.794	0.267 0.984

Resident *O. mykiss* considerations

The available information on resident *O. mykiss* populations within the ESU is summarized in Table B.2.1.3 and Appendix B.5.1 and provides a broad overview of the distribution of Case 1, 2, and 3 resident populations within the ESU. See the section on Resident Fish in the Introduction section to the main body of this report for an explanation of the three cases and their relevance to ESU determinations. The section on Resident Fish in section B.1 of this steelhead report discusses how resident fish are considered in risk analyses.

Kostow (2003) has reviewed information on the abundance and distribution of resident trout for this ESU. IDFG presence/absence survey results indicate that *O. mykiss* were found in 48% of the 84 streams sampled throughout the Salmon River Basin. Westslope Cutthroat Trout were found in 43% of the locations sampled. When the species co-occurred in a tributary system, the cutthroat trout tended to be found in smaller headwater tributaries, while *O. mykiss* were in larger tributaries lower in the system. Steelhead occupied lower mainstem and associated tributaries. IDFG has suggested that some of the resident rainbow in the Salmon and Clearwater drainages may be the result of hatchery rainbow introductions.

The relative abundance of resident *O. mykiss* in the Imnaha and Grande Ronde River basins has not been clearly defined. *O. mykiss* production has been documented in both basins. Kostow (2003) reports that while no formal surveys of resident trout abundance have been conducted in the Imnaha River basin, the results of genetics sampling in the basin support the presence of a resident form. Resident O. mykiss abundance in the Tucannon River is believed to be relatively low based on observations during steelhead redd count surveys (Kostow 2003).

Resident *O. mykiss* populations are present above the Hells Canyon Dam complex, but their relationship to existing steelhead populations below the dams has not been determined (Kostow 2003). There have been relatively few specific studies of potential relationships between sympatric resident and anadromous *O. mykiss* in the Snake River basin.

Table B.2.1.3. Distribution of *O. mykiss* trout by category relative to the Snake Basin steelhead ESU. Only major barriers are noted; numerous small barriers, both natural and artificial, also exist. Many other natural barriers are present but have *O. clarki* trout, rather than *O. mykiss* trout, above them. *O. mykiss* trout distribution in areas of sympatry with steelhead may be restricted in some areas if native *O. clarki* trout are also in the basin. The generalized listing of basins and subbasins does not imply that these constitute single trout populations or that trout distribution is continuous throughout the areas listed. Detailed trout distribution is usually unknown and actual demographically independent trout populations have not been described. All current trout distributions are decreased from historical distributions. In particular many mainstem and lower basin tributary are no longer used but probably were historically. Many current trout populations are only in upper basins and are highly fragmented.

ESU	**Category 1 Trout Populations (Sympatric)**	**Category 2 Trout Populations (Major Natural Barriers)**	**Category 3 Trout Populations (Major Artificial Barriers)**
Snake River Basin steelhead	Potentially all areas that are/were used by steelhead. Tucannon Asotin Grande Ronde Imnaha Salmon found in about 43% of streams Clearwater Selway Other areas?	Palouse River Malad River Several Hells Canyon tributaries Upper Malheur Basin "recent" disconnect from lower Malheur Lakes Basin	Trout distributions currently more restricted than historically North Fork Clearwater (Dworshak Dam) Mainstem Snake (Hells Canyon Dam) Powder Burnt Malheur Owyhee Weiser Payette Boise Burneau Salmon Falls Cr. Several small tributaries

Genetic analysis of Case 3 resident *O. mykiss* above Dworshak Dam shows that the sampled population is genetically more similar to Dworshak steelhead than are other Snake River *O. mykiss* populations (Waples 1998; Waples et al. 1993). This suggests that the sampled population may be derived primarily from residualized steelhead or native resident fish from the North Fork Clearwater River. However, the genetic data cannot rule out some introgression from non-native rainbow trout.

Kostow (2003) reported that field biologists noted spatial and temporal overlaps in spawning between resident and anadromous *O. mykiss* in the Grande Ronde, Imnaha, Tucannon and Upper Snake River basins. ODFW is conducting experimental cross breeding studies using resident and anadromous *O. mykiss* from the Grande Ronde Basin. Preliminary results indicate that all potential crosses produce outmigrating smolts. Steelhead x steelhead crosses had the highest smolt production rate and resident trout x resident trout crosses had the lowest. Adult female steelhead x resident male trout crosses, the combination most likely to occur in nature, had the second highest smolt production rate. Adult returns from the study are forthcoming.

Wishard et al. (1984), Williams et al. (1996), and Leary (2001) have genetically examined Case 3 resident populations in tributaries above the Hells Canyon Dam complex and have concluded that some populations are native redband trout but others are hybridized with hatchery rainbow trout. A number of genetic studies of Snake River *O. mykiss* that are currently underway should provide more specific information about resident populations in the future.

B.2.1.3. New Hatchery Information

Artificial production history

Almost all artificial production of steelhead within the Snake River ESU has been associated with two major mitigation initiatives—the Lower Snake River Compensation Program (LSRCP) and the mitigation program for Dworshak Dam on the North Fork of the Clearwater River. The LSRCP is administered by the USFWS and was established as compensation for losses incurred as a result of the construction and operation of the four lower Snake River hydroelectric dams. Production under this initiative generally began in the mid 1980s. The Dworshak mitigation program provides for artificial production as compensation for the loss of access to the North Fork Clearwater, a major historical production area. Dworshak Hatchery, completed in 1969, is the focus for that production.

Hatchery releases of steelhead within the Snake River ESU are summarized by time period and production area in Table B.2.1.4. The following sections summarize historical and current artificial production programs for steelhead by major geographic area within the ESU.

Table B.2.1.4. Hatchery releases of steelhead in the Snake River basin, organized by major steelhead production areas and broodstock of the release. Averages calculated by time period to facilitate comparison of release levels since the last BRT review with previous levels.

Basin	**Stock**	**Average releases per year**		
		1985 - 1989	**1990 - 1994**	**1995 - 2001**
Mainstem Snake	Dworshak B	2,400	1,760	-
	Lyons Ferry	141,383	72,306	73,616
	Oxbow A	912,769	651,723	440,999
	Salmon River A	68,800	-	93,325
	Wallowa	205,133	138,915	-
	Wells	112,559	-	-
	Mixed	20,352	-	-
	Imnaha River	-	6,722	-

	Snake River A			95,018
	Pahsimeroi A	-	8,695	-
	Mainstem Total	1,463,397	880,123	702,958
Tucannon	Lyons Ferry	32,300	14,116	151,723
	Tucannon River	157,469	62,860	8,574
	Wallowa	16,197	-	-
	Wells	40,229	-	-
	Pahsimeroi A	-	23,852	-
	Mixed	-	26,008	-
	Tucannon Total	246,197	126,838	160,297
Asotin	Lyons Ferry	16,895	6,092	16,328
	Oxbow A	-	27,200	-
	Pahsimeroi A	-	27,569	-
	Wallowa	5,800	-	-
	Wells	8,930	-	-
	Asotin Total	31,625	60,861	16,328
Mainstem Clearwater	Dworshak B	1,618,440	1,893,944	1,755,111
	Clearwater B	-	-	113,581
North Fork Clearwater	Dworshak B	-	-	391,210
South Fork Clearwater	Clearwater B	-	-	85,398
	Dworshak B	612,152	869,839	739,543
	Selway River	-	14,313	19,483
	Clearwater Total	2,230,593	2,778,097	3,104,325
Mainstem Grande Ronde	Wallowa	782,060	616,379	975,089
Wallowa	Wallowa	529,852	985,339	524,416
	Grande Ronde Total	1,311,912	1,601,718	1,499,505
Lower & Mainstem Salmon	Salmon River A	325,000	432,867	161,537
	Salmon River B	9,900	-	24,940
	Dworshak B	-	112,291	109,015
Basin	**Stock**	**Average releases per year**		
		1985 - 1989	**1990 - 1994**	**1995 - 2001**
	Oxbow A	-	100,972	63,879
	Pahsimeroi A	-	235,306	68,695
Little Salmon	Hagerman A	61,621	-	-
	Oxbow A	120,261	200,380	341,639
	Salmon River A	399,135	232,716	271,400
	Dworshak B	-	367,068	222,438
	Pahsimeroi A	-	65,632	39,933
	Salmon River B	-	-	48,471
Panther	Pahsimeroi A	49,264	-	-
	Salmon River A	141,100	-	-

North Fork Salmon	Salmon River A	92,300	71,600	30,070
	Oxbow A	-	26,995	-
	Pahsimeroi A	-	38,100	43,500
Lemhi	Dworshak B	125,000	86,857	-
	Pahsimeroi A	-	-	132,741
	Salmon River A	-	-	129,287
Pahsimeroi	Pahsimeroi A	845,968	693,118	718,435
	Salmon River A	-	-	114,506
East Fork Salmon	E Fk Salmon B	475,023	197,670	34,283
	Dworshak B	87,315	773,329	240,523
	Hagerman B	54,042	-	-
	Salmon River B	-	-	71,494
Upper Salmon	Hagerman A	157,237	-	-
	Pahsimeroi A	-	447,944	368,748
	Salmon River A	889,353	669,844	590,289
	Dworshak B	-	-	130,186
	Salmon River B	-	-	18,387
	Sawtooth A	-	-	32,348
	Salmon Total	3,832,518	4,752,697	4,006,745
Imnaha	Imnaha River	188,275	325,833	169,758
	Little Sheep Creek	-	-	131,776
	Imnaha Total	188,275	325,833	301,534
ESU Total	All Stocks	10,097,233	10,526,167	10,033,360

Tucannon River—Artificial production of steelhead in the Tucannon River has been carried out since the early 1980s in response to the LSRCP objective of 878 steelhead to the project area. Until 1998, releases of hatchery steelhead into the Tucannon River occurred via the upriver Curl Lake acclimation site. Release numbers ranged from 120,000 to 160,000 between 1985 and 1997. The broodstock for Tucannon releases was primarily the Lyons Ferry stock, which was originally derived from Wells Hatchery and Wallowa Hatchery stocks. The Wallowa Hatchery stock was originally derived by ODFW through trapping returning adults in the lower Snake River. Pahsimeroi Hatchery stock was used in the program in one year when full production was lost at Lyons Ferry due to disease outbreaks, primarily IHNV (Gephart and Nordheim 2001).

Return rates to the Tucannon River from the hatchery program have been relatively low. Beginning in 1998, the release location for hatchery steelhead was moved down river in response to studies indicating improved survivals from lower river releases and to minimize the opportunity for interbreeding between hatchery and natural returns (included listed spring chinook) to the basin. Beginning with the 1999/2000-cycle year, the Tucannon River hatchery steelhead program began an evaluation of the feasibility of using local broodstock for the program. A full switch over to an endemic broodstock may occur in the future, depending upon the success of the pilot program. Problems associated with trapping and rearing of the new broodstock, as well as genetic questions still need to be addressed (B. Leland WDFW, pers. comm.).

Grande Ronde/Imnaha Rivers—There are LSRCP steelhead hatchery mitigation releases in the Grande Ronde and Imnaha River systems. The LSRCP compensation objective for Grande Ronde steelhead returns is 9,200. Trapping facilities for adult broodstock are located at Big Canyon Creek acclimation site. The original program used outside broodstock (including Skamania Hatchery stock) from 1979-1982 before switching to the Wallowa broodstock. Smolts are acclimated and released at two sites—one within the Wallowa drainage, the other at Big Canyon Creek. Oregon manages the Minam River, Joseph Creek and the Wenaha River drainages for natural production. Other sections of the Grande Ronde have been outplanted to supplement natural production (Nowak 2001).

LSCRP program releases into the Imnaha River are released from a satellite facility on Little Sheep Creek after primary rearing at Wallowa Hatchery. Additional releases are targeted in Horse Creek and the Upper Imnaha basin (Bryson 2001).

Clearwater Basin—Steelhead hatchery releases into the Clearwater basin are managed under two programs—LRSCMP and Dworshak Dam mitigation. The Lower Snake Compensation Plan program in the Clearwater River drainage utilizes the Clearwater hatchery as a central rearing facility and has an overall production objective of 14,000 adult steelhead returns to the Snake River. Program release sites include acclimation ponds on the Powell River (Lochsa River drainage), the Red River, and Crooked River sites in the South Fork of the Clearwater River. The Dworshak mitigation program has an adult return objective of 20,000 adult steelhead as compensation for losses due to Dworshak Dam, an anadromous block that cuts off the North Fork of the Clearwater River. Genetics studies have indicated that the hatchery stock used in the Dworshak program may be representative of the original North Fork run (Cichosz et al. 2001).

Salmon River Basin—Steelhead hatchery releases into the Salmon River drainage are under the auspices of two major steelhead hatchery programs—LSRCP and Idaho Fish and Game Department programs funded by Idaho Power Company. In addition, there are state and tribal experimental supplementation programs in the drainage. The LSRCP program goal for the Salmon basin is to produce an annual return of 25,000 adult steelhead above Lower Granite Dam. Juvenile steelhead produced at Magic Valley Hatchery and Hagerman National Fish Hatchery are released into the Salmon drainage. The Idaho Power Company-funded program for steelhead has an objective of releasing 400,000 pounds of steelhead smolts (Servheen 2001).

The Middle Fork Salmon drainages have had minimal or no hatchery releases. The Upper Salmon drainages, the Pahsimeroi, Lemhi, Little Salmon River and Lower Salmon River areas have received releases in recent years.

Categorizations of hatchery Snake River Basin hatchery stocks (SSHAG 2003) are summarized in Appendix B.5.3.

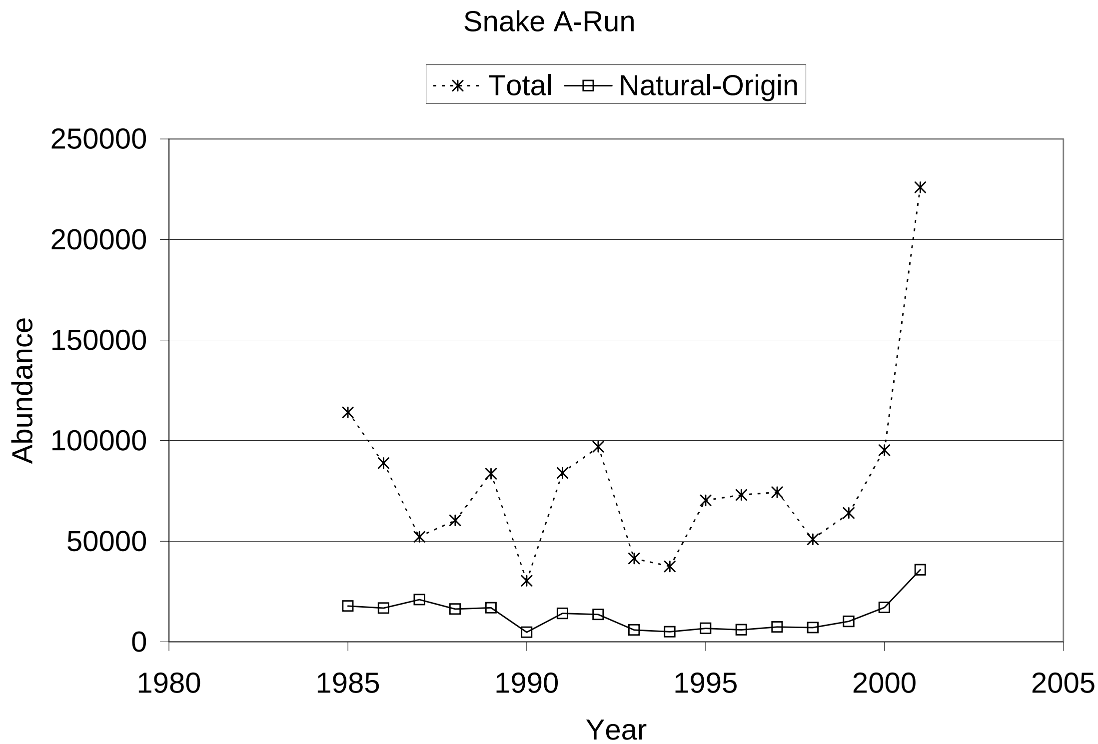

Figure B.2.1.1. Lower Granite Dam counts of Snake River A-run steelhead: US v Oregon Technical Advisory Committee estimates (source: H. Yuen, USFWS, Vancouver, WA).

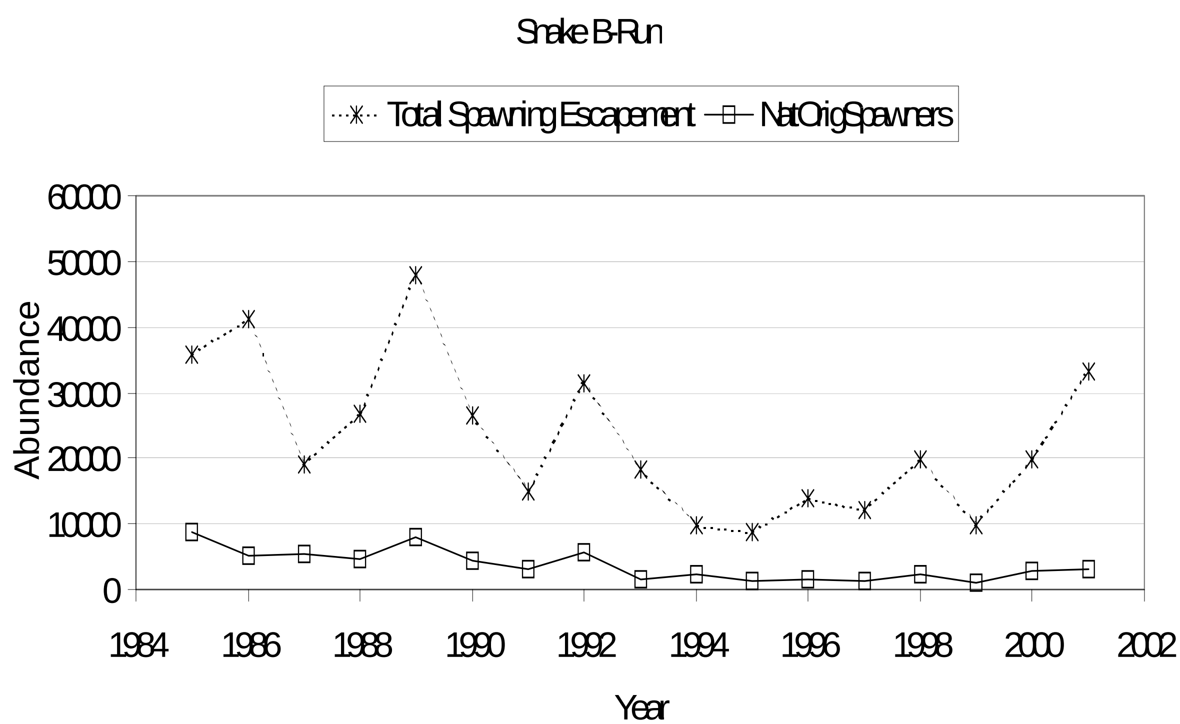

Figure B.2.1.2. Lower Granite Dam counts of Snake River B-run steelhead: US v Oregon Technical Advisory Committee estimates (source: H. Yuen, USFWS, Vancouver, WA).

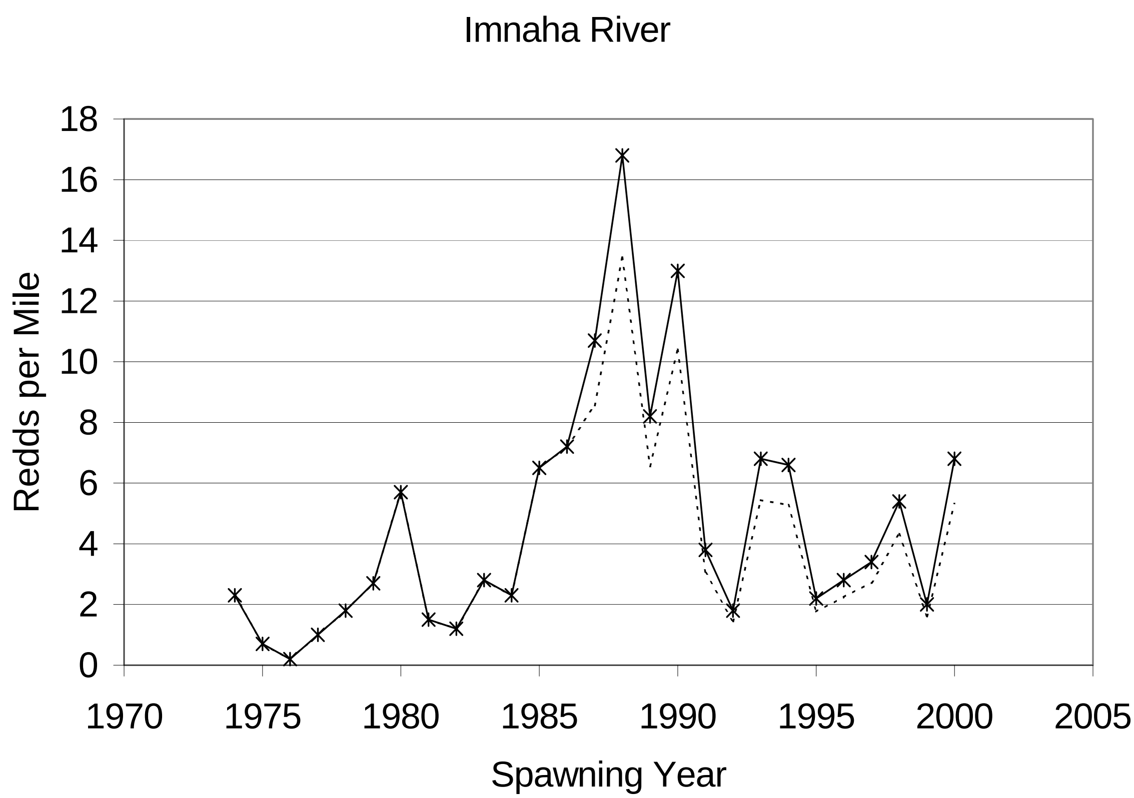

Figure B.2.1.3. Spawner abundance counts (redds/mile) for Imnaha River steelhead.

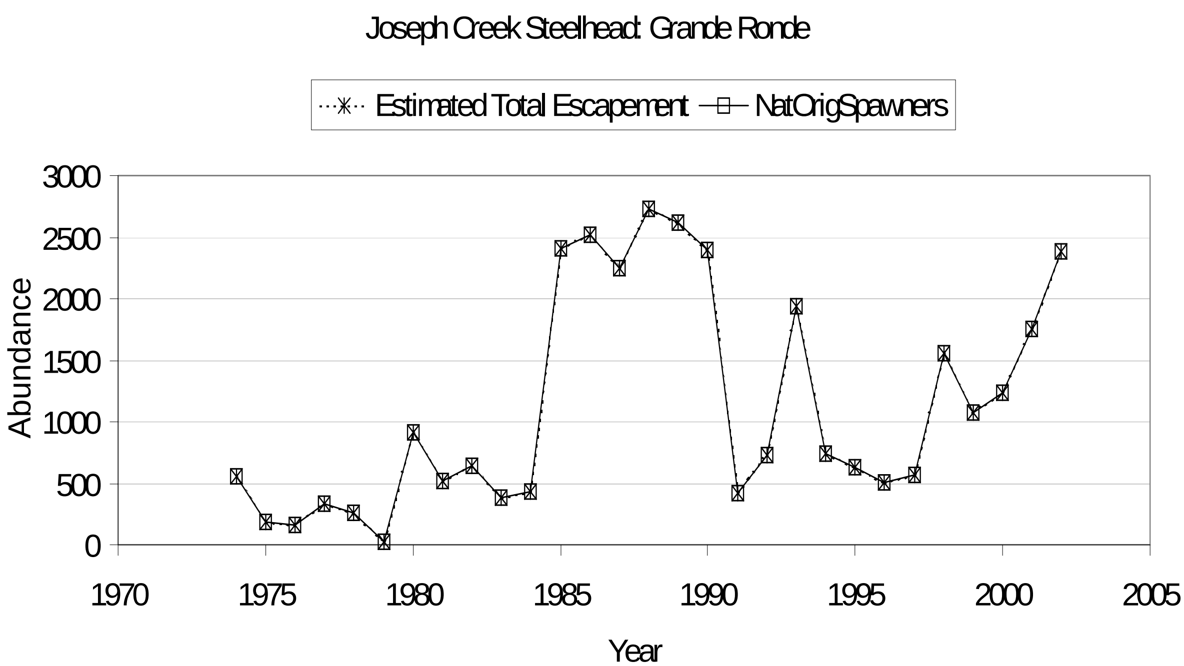

Figure B.2.1.4. Spawner escapement for Joseph Creek steelhead: Grande Ronde. Expanded from redd counts (ODFW).

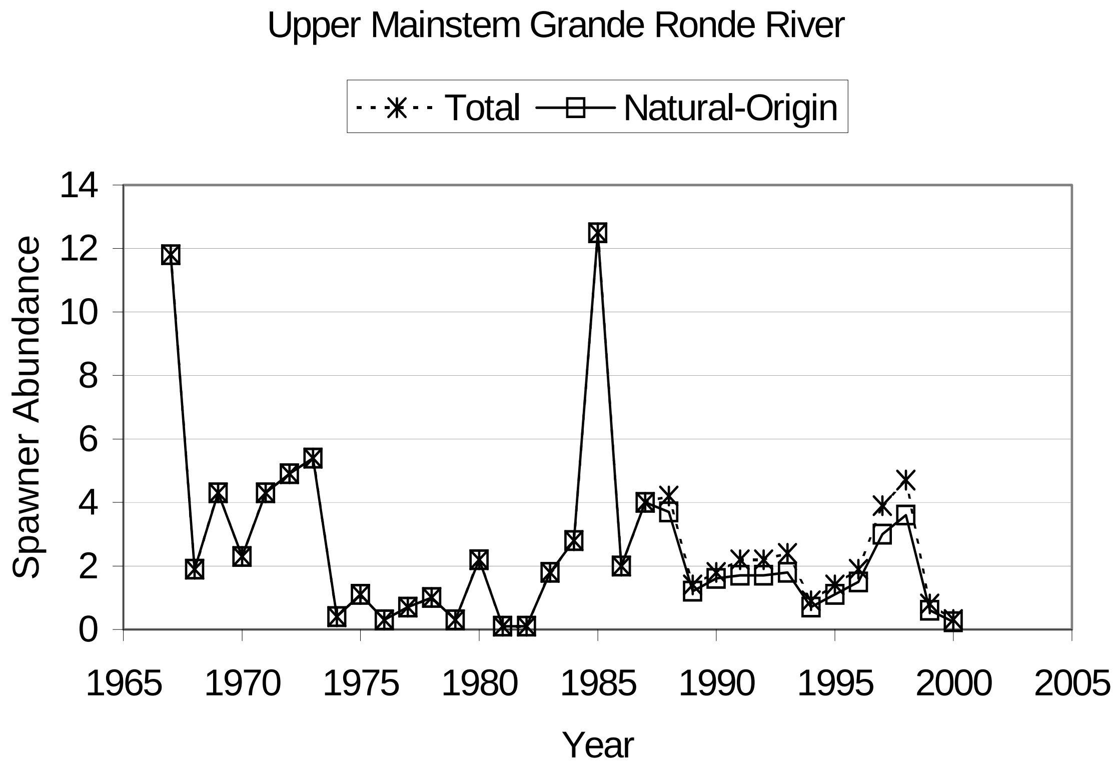

Figure B.2.1.5. Spawner escapement for the Upper Mainstem Grande Ronde River (ODFW spawning ground survey data).

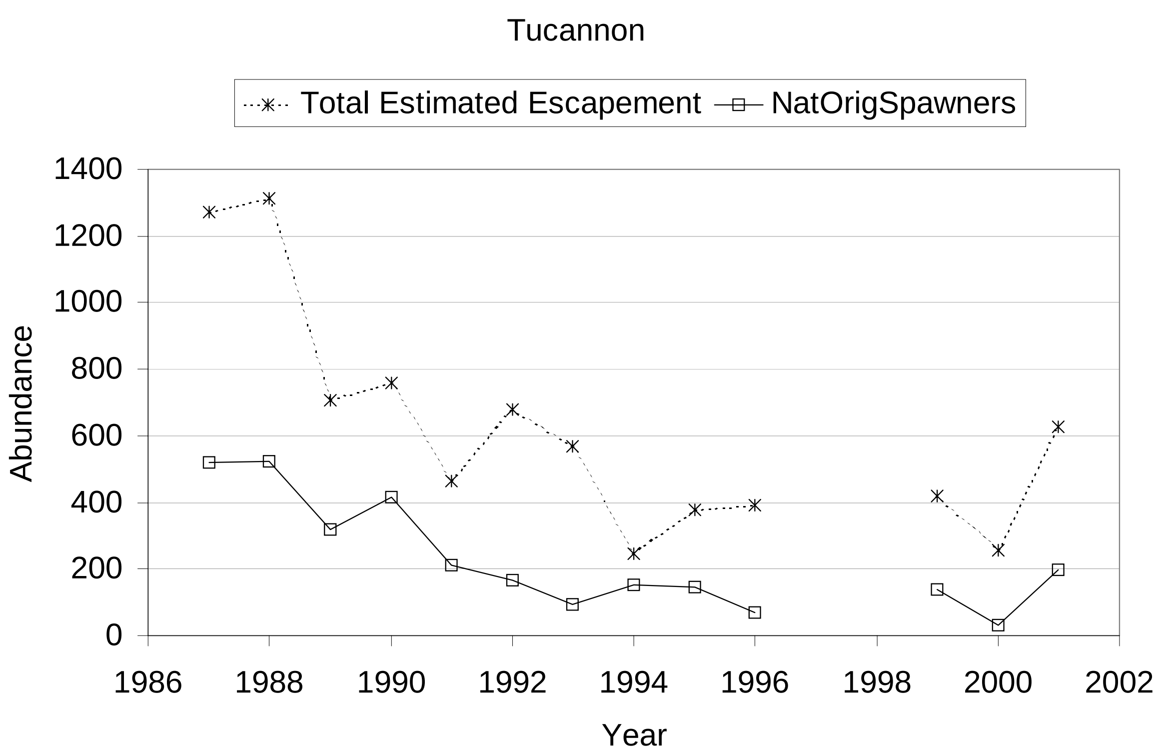

Figure B.2.1.6. Estimated spawner escapement for Tucannon River steelhead (WDFW).

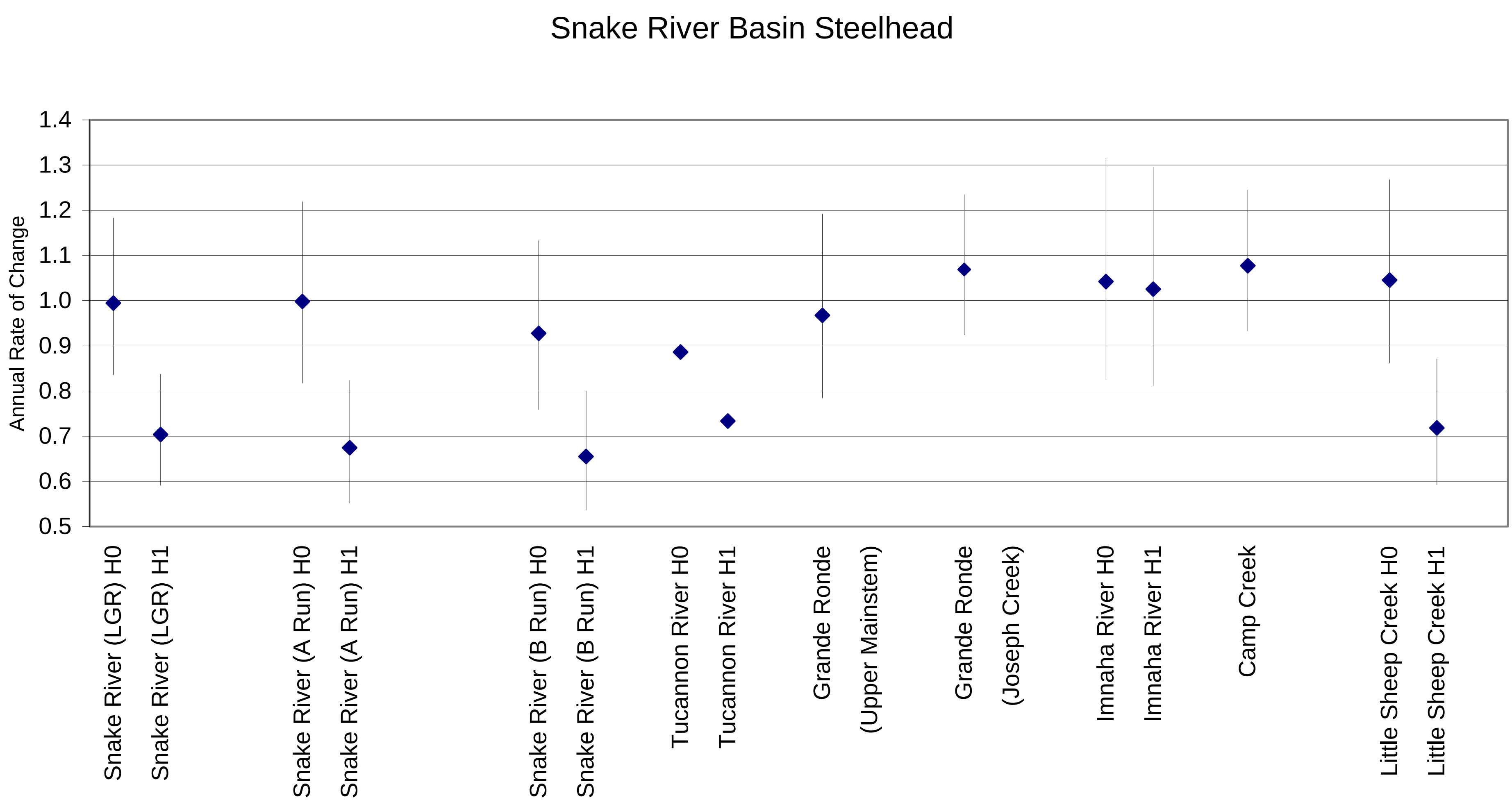

Figure B.2.1.7. Long term median population growth rate estimates and 95% confidence limits for the Snake River Basin steelhead ESU. Paired estimates are based on calculations where hatchery-origin spawners have reproductive success equal to zero (H0) or equivalent to natural-origin spawners (H1) (some hatchery confidence limits estimated by extrapolation).

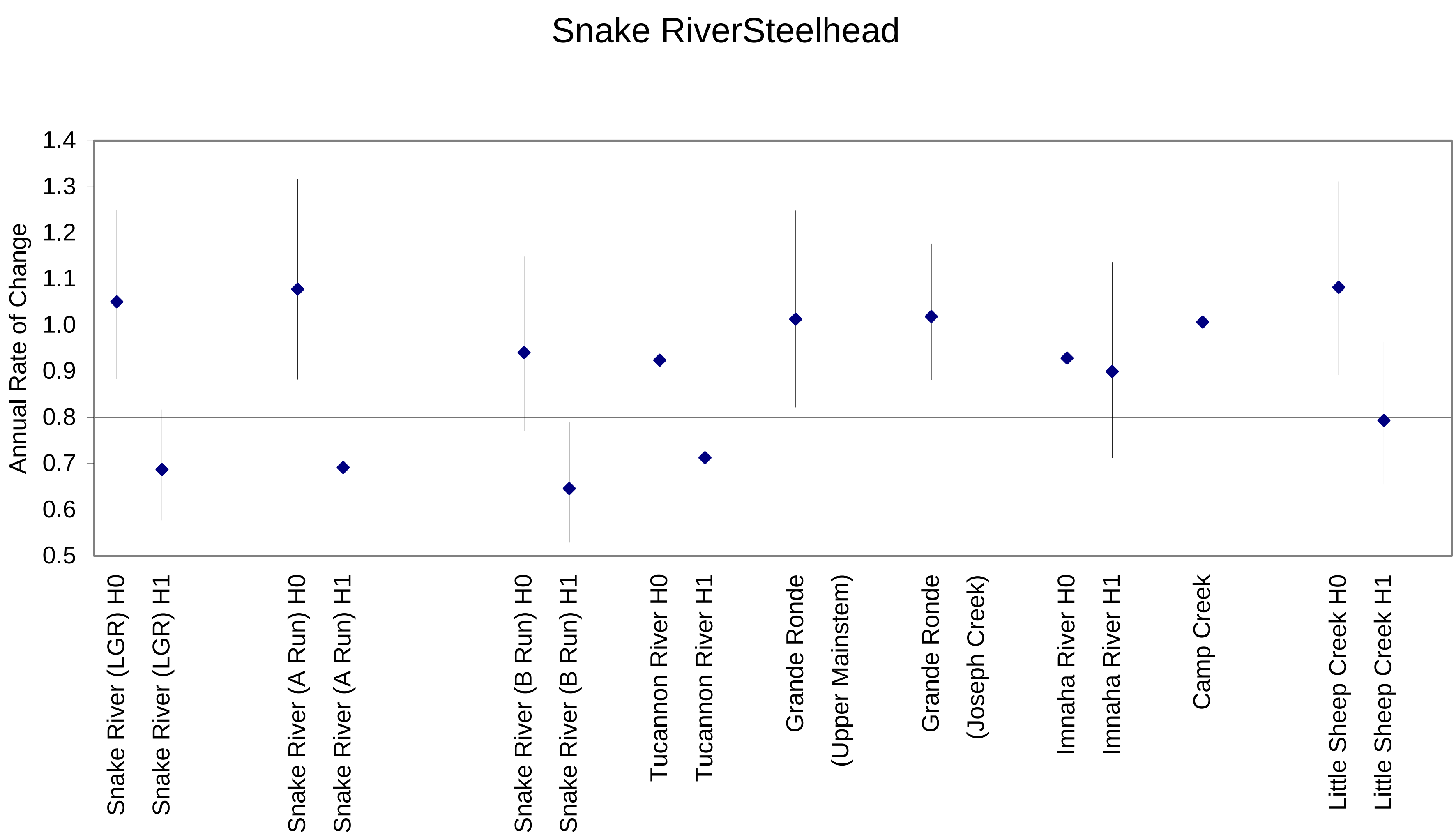

Figure B.2.1.8. Short-term median population growth rate estimates and 95% confidence limits for the Snake River Basin steelhead ESU. Paired estimates are based on calculations where hatchery-origin spawners have reproductive success equal to zero (H0) or equivalent to natural-origin spawners (H1).

B.2.2. UPPER COLUMBIA RIVER STEELHEAD

Primary contributor: Thomas Cooney
(Northwest Fisheries Science Center)

The life-history patterns of Upper Columbia River steelhead are complex. Adults return to the Columbia River in the late summer and early fall; most migrate relatively quickly up the mainstem to their natal tributaries. A portion of the returning run overwinters in the mainstem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the calendar year following entry into the river. Juvenile steelhead spend 1 to 7 years rearing in freshwater before migrating to the ocean. Smolt outmigrations are predominately age 2 and age 3 juveniles. Most adult steelhead return after 1 or 2 years at sea, starting the cycle again.

Estimates of the annual returns of upper Columbia River steelhead populations are based on dam counts. Cycle counts are used to accommodate the prevalent return pattern in up-river summer steelhead (runs enter the Columbia River in late summer and fall, some fish overwinter in mainstem reservoirs—migrating past the upper dams prior to spawning the following spring). Counts over Wells Dam are assumed to be returns originating from natural production and hatchery outplants into the Methow and Okanogan river systems. The total returns to Wells Dam are calculated by adding annual broodstock removals at Wells to the dam counts. The annual estimated return levels above Wells Dam are broken down into hatchery and wild components by applying the ratios observed in the Wells sampling program for run years since 1982.

Harvest rates on upper river steelhead have been cut back substantially from historical levels. Direct commercial harvest of steelhead in non-Indian fisheries was eliminated by legislation in the early 1970s. Incidental impacts in fisheries directed at other species continued in the lower river, but at substantially reduced levels. In the 1970s and early 1980s, recreational fishery impacts in the upper Columbia escalated to very high levels in response to increasing returns augmented by substantial increases in hatchery production. In 1985, steelhead recreational fisheries in this region (and in other Washington tributaries) were changed to mandate release of wild fish. Treaty harvest of summer run steelhead (including returns to the upper Columbia) occurs mainly in mainstem fisheries directed at up-river bright fall chinook.

Hatchery returns predominate the estimated escapement in the Wenatchee, Methow and Okanogan River drainages. The effectiveness of hatchery spawners relative to their natural counterparts is a major uncertainty for both populations. Hatchery effectiveness can be influenced by at least three sets of factors: relative distribution of spawning adults, relative timing of spawning adults, and relative effectiveness of progeny. No direct information is available for the upper Columbia River stocks. Outplanting strategies have varied over the time period the return/spawner data were collected (1976-1994 broodyears). While the return timing into the Columbia River is similar for both wild and hatchery steelhead returning to the upper Columbia, the spawning timing in the hatchery is accelerated. The long-term effects of such acceleration on the spawning timing of returning hatchery-produced adults in nature is not known. We have no direct information on relative fitness of upper Columbia River steelhead progeny with at least one parent of hatchery origin.

B.2.2.1. Summary of Previous BRT Conclusions

The 1998 steelhead status review identified a number of concerns for the Upper Columbia River Steelhead ESU: "While the total abundance of populations within this ESU has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. Estimates of the proportion of hatchery fish in spawning escapement are 65% (Wenatchee River) and 81% (Methow and Okanogan Rivers). The major concern for this ESU is the clear failure of natural stocks to replace themselves. The BRT members are also strongly concerned about the problems of genetic homogenization due to hatchery supplementation...apparent high harvest rates on steelhead smolts in rainbow trout fisheries and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric Dams." The BRT also identified two major areas of uncertainty; relationship between anadromous and resident forms, and the genetic heritage of naturally spawning fish within this ESU.

B.2.2.2. New Data and Updated Analyses

Population definitions and criteria

An initial set of population definitions for the Upper Columbia River steelhead ESU along with basic criteria for evaluating the status of each population were developed using the Viable Salmonid Population (VSP) guidelines described in McElhany (2000). The definitions and criteria are described in Ford et al. (2000) and have been used in the development and review of Mid-Columbia PUD plans and the FCRPS Biological Opinion. The interim definitions and criteria are being reviewed as recommendations by the Interior Columbia Technical Recovery Team. Briefly, the joint technical team recommended that the Wenatchee River, the Entiat River and the Methow River be considered as separate populations within the Upper Columbia River Steelhead ESU. The Okanogan River may have supported a fourth population; the committee deferred a decision on the Okanogan to the Technical Recovery Team. Abundance, productivity and spatial structure criteria for each of the populations in the ESU were developed and are described in Ford et al. (2001).

Current abundance

Returns of both hatchery and naturally produced steelhead to the upper Columbia River have increased in recent years. Priest Rapids Dam is below Upper Columbia River steelhead ESU production areas. The average 1997-2001 return counted through the Priest Rapids fish ladder was approximately 12,900 steelhead. The average for the previous 5 years (1992-1996) was 7,800 fish.

Total returns to the upper Columbia River continue to be predominately hatchery-origin fish. The natural-origin percentage of the run over Priest Rapids increased to over 25% in the 1980s, then dropped to less than 10% by the mid-1990s. The median percent of natural-origin for 1997-2001 was 17%. Abundance estimates of returning naturally produced Upper Columbia River steelhead have been based on extrapolations from mainstem dam counts and associated sampling information (e.g. hatchery/wild fraction, age composition). The natural component of the annual steelhead run over Priest Rapids increased from an average of 1,040 (1992-1996) to 2,200 (1997-2001).

The estimate of the combined natural steelhead return to the Wenatchee and Entiat rivers increased to a geometric mean of approximately 900 for the 1996-2001 period. The average percentage natural dropped from 35% to 29% for the recent 5-year period. In terms of natural production, recent production levels remain well below the interim recovery levels developed for these populations (Table B.2.2.1, Figure B.2.2.1).

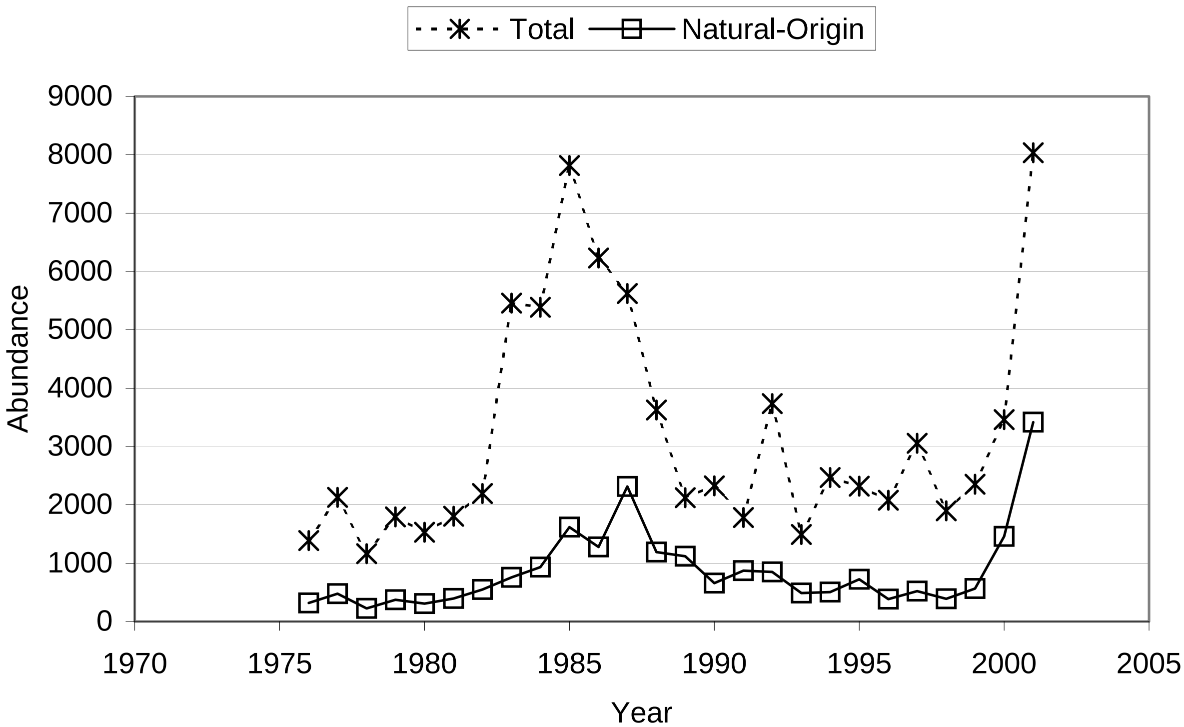

Figure B.2.2.1. Wenatchee/Entiat Rivers steelhead—estimated annual spawner escapements. Cooney, 2001. 1999-2001 data from WDFW.

The Methow River steelhead population is the primary natural production area above Wells Dam. The 1997-2001 geometric mean of natural returns over Wells Dam was 358, lower than the geometric mean return prior to the 1998 status review (Table B.2.2.1, Figure B.2.2.2). The most recent return reported in the data series, 1,380 naturally produced steelhead in 2001, was the highest single annual return in the 25-year data series. Hatchery returns continue to dominate the run over Wells Dam. The average percent of wild origin dropped to 9% for 1996-2001 compared to 19% for the period prior to the previous status review.

Table B.2.2.1. Upper Columbia River steelhead. Summary of current abundance and trend information relative to previous BRT status review. Interim targets from Ford et al. (2001).

Population	5-year mean % natural origin	Recent 5-year geometric mean			Short-term Trend (%/yr)		Interim Target	Current vs. Target
		Total	Natural					
		Mean (Range)	Current	Previous	Current	Previous		
Wenatchee/ Entiat	29 (35*)	3,279 (1,899-8,036)	894	800	+6.5	+2.6	3,000	30%
Methow/ Okanogan	9 (19*)	3,714 (1,879-12,801)	358	450	+13.8	-12.0	2,500	14%

* estimates from previous status review

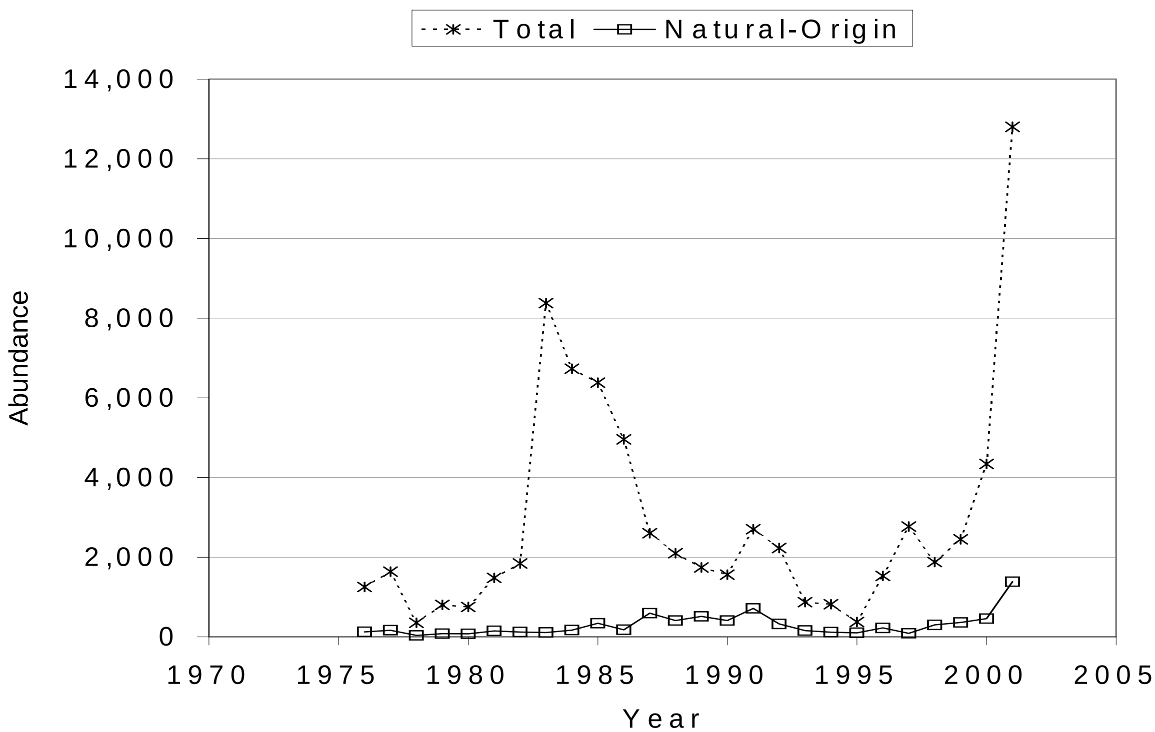

Figure B.2.2.2. Methow River steelhead—estimated annual spawner escapements. Cooney 2001. 1999-2001 data from WDFW.

The analyses described above relied on the 1976-2001 abundance data set. The starting date for that series is set by the advent of counting at Wells Dam (allowed for separate estimates of run strength to the Methow/Okanogan rivers and the Wenatchee/Entiat rivers). The median run (almost all natural origin) from 1933-1954 was approximately 2,300.

Current productivity

Natural returns have increased in recent years for both stock groupings (Table B.2.2.2). Population growth rates, expressed as λ calculated using the running sum method, are substantially influenced by assumptions regarding the relative effectiveness of hatchery spawners. The same key factor must be considered in analyzing return-per-spawner data sets. The relative contribution of returning steelhead of hatchery origin to natural spawning is not clearly understood. There may be timing and spatial differences in the distribution of hatchery and wild origin spawners that affect production of juveniles. Eggs and subsequent juveniles, from natural spawning, involving hatchery-origin fish may survival at a differential rate relative to spawning of natural-origin adults.

Both short-term (1990-present) and long-term (1976-present) estimates of λ are positive under the assumption that hatchery fish have not contributed to natural production in recent years. λ estimates under the assumption that hatchery fish contributed at the same level as wild fish to natural production are substantially lower—under this scenario natural production is consistently and substantially below the total number (hatchery plus natural origin) of spawners in any given year. This result is consistent with those of McClure et al. (2003) and those in the 2000 FCRPS Biological Opinion (NMFS 2000), in which lambda was estimated from the ESU-level time series for the time period 1980-2000. Although the total spawners have an apparent population growth rate of 1.00 (with relatively high variability), this growth rate is lowered to 0.69 if hatchery fish contributed to subsequent generations at the same rate that wild fish do. Clearly, determining the actual contribution of hatchery fish will be an important element in determining the true status of this ESU.

Return-per-spawner patterns for the two steelhead production areas are also substantially influenced by assumptions regarding the relative effectiveness of hatchery-origin spawners (Figures B.2.2.3 and B.2.2.4). Under the assumption that hatchery and wild spawners are both contributing to the subsequent generation of natural returns, return-per-spawner levels have been

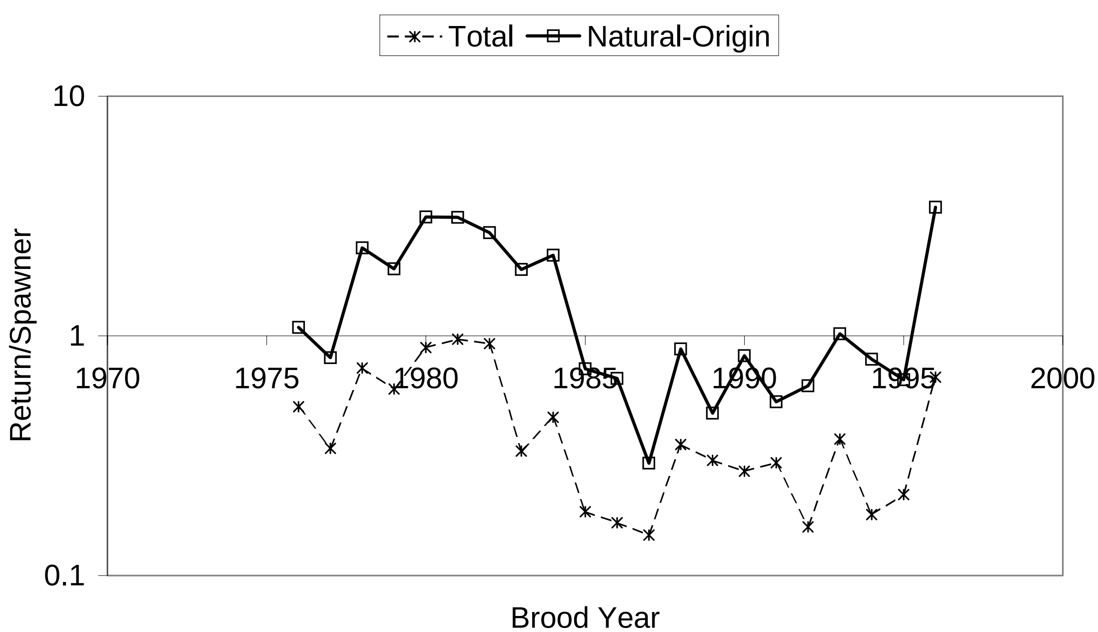

Figure B.2.2.3. Wenatchee/Entiat River steelhead—return-per-spawner vs. broodyear spawning escapement.

Table B.2.2.2: Upper Columbia River steelhead population growth rate analysis. Summary of available trend data sets, results of calculating annual population growth rates (λ: geomean, probability geomean less than 1.0) Long-term = the length of the available data series, Short term = 1990 -2001 or most recent year. Population growth rates calculated for two hatchery effectiveness (HF) assumptions: HF = 0.0 hatchery fish available to spawn do not contribute to natural production; HF = 1.0 hatchery returns available to spawn contribute to broodyear natural production at the same rate as natural-origin spawners. Methods: DC – Dam counts.

Upper Columbia River Steelhead	**Series Length**	**Method**	**% wild 1987-1996**	**% wild 1997-2001**	**1997-2001 geomean**	**HF**	**Long-term λ**	**Prob. λ<1**	**Short-term λ**	**Prob. λ<1**
Wenatchee/Entiat	1976-2001	DC	0.33	0.29	894	0 1	1.067 0.733	0.112 1.000	1.093 0.753	0.219 0.987
Above Wells Dam	1976-2001	DC	0.17	0.085	358	0 1	1.086 0.579	0.088 1.000	1.277 0.565	0.357 1.000
Methow River	1976-2001	DC	0.21	0.11	358	0 1	1.086 0.589	0.088 1.000	1.277 0.621	0.357 1.000

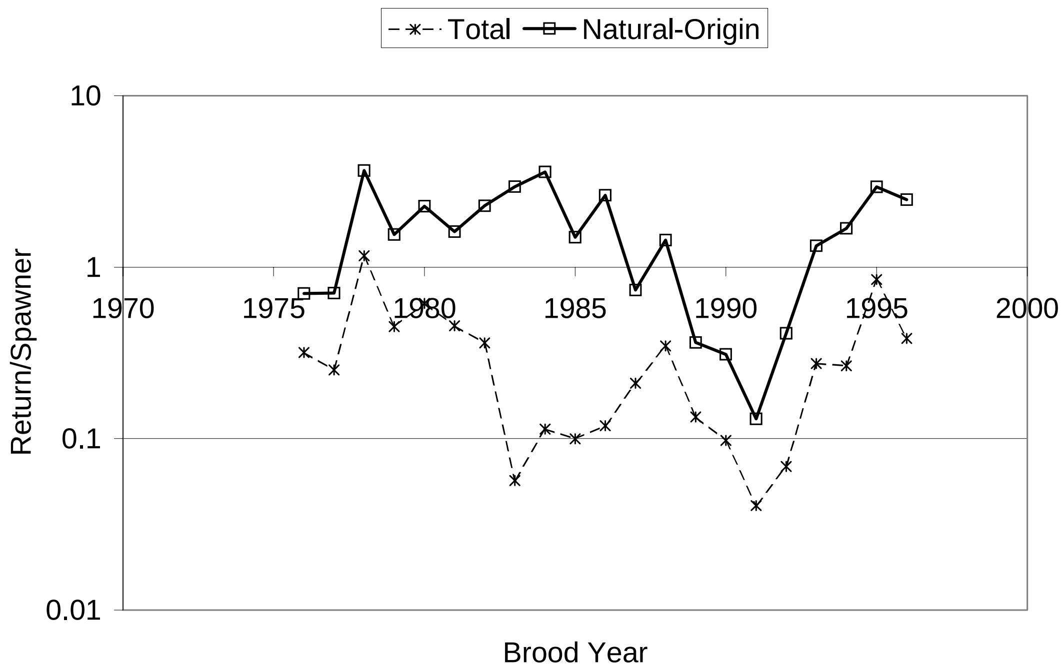

Figure B.2.2.3. Methow River steelhead—return-per-spawner vs. broodyear spawning escapement.

consistently below 1.0 since 1976. Under this scenario natural production would be expected to decline rapidly in the absence of hatchery spawners. Under the assumption that hatchery fish returning to the upper Columbia River do not contribute to natural production, return-per-spawner levels were above one until the late 1980s. Return-per-spawner estimates subsequently dropped below replacement (1.0) and remained low until the most recent broodyear with measured returns—1996. The actual contribution of hatchery returns to natural spawning remains a key uncertainty for upper Columbia River steelhead. This information need is in addition to any considerations for long-term genetic impacts of high hatchery contributions to natural spawning.

Resident *O. mykiss* considerations

This section summarizes available information on resident *O. mykiss* populations within the ESU. Table B.2.2.3 and Appendix B.5.1 provide a broad overview of the distribution of Case 1, 2, and 3 resident populations within the ESU. See the section on Resident Fish in the Introduction section to the main body of this report for an explanation of the three cases and their relevance to ESU determinations. The section on Resident Fish in section B.1 of this steelhead report discusses how resident fish are considered in risk analyses.

Resident *O. mykiss* are relatively abundant in upper Columbia River tributaries currently accessible to steelhead as well as in upriver tributaries blocked off to anadromous access by Chief Joseph and Grand Coulee dams (Kostow 2003 draft). USFWS biologists surveyed the abundance of trout and steelhead juveniles in the Wenatchee, Entiat, and Methow River drainages in the mid 1980s (Mullan 1992). Adult trout (defined as trout > 20 cm) were found in surveys in all basins. Juvenile *O. mykiss* were reported from 94% of the surveys conducted in areas believed to be used by steelhead and resident trout (Kostow 2003 draft). The results also supported the hypothesis that resident *O. mykiss* are more abundant in tributary/mainstem areas above the general areas used by steelhead for rearing.

The original status review did not formally evaluate the current ESU status of resident populations above Chief Joseph Dam, nor did it formally consider whether *O. mykiss* in upper Columbia River tributaries historically were in the same ESU as populations in the Wenatchee, Entiat, Methow, and Okanogan Rivers. Kostow (2003) reports that biologists who are familiar with the areas above Chief Joseph Dam believe that *O. mykiss* are present in significant numbers. Several of the tributaries above Chief Joseph Dam have been blocked off by dams, and introductions of exotic gamefish and trout species have been widespread. We are not aware of specific information relevant to the ESU status of Case 3 resident populations above dams in the Okanogan or Spokane Rivers, or above Chief Joseph and Grand Coulee Dams on the mainstem Columbia River. *O. mykiss,* believed to be native populations, are present in a number of tributaries draining into Lake Roosevelt (Kostow 2003). Mullan (1992) hypothesized that the native trout populations above Chief Joseph Dam effectively preserved native steelhead lineages present before the construction of the mainstem impassable dams. Knudsen et al (2002) concluded that native resident (Case 2) populations persist in some Kootenai River tributaries, in spite of extensive stocking by non-native rainbow trout.

Table B.2.2.3. Distribution of *O. mykiss* trout by category relative to the Upper Columbia River steelhead ESU. Only major barriers are noted; numerous small barriers, both natural and artificial, also exist. Many other natural barriers are present but have *O. clarki* trout, rather than *O. mykiss* trout, above them. *O. mykiss* trout distribution in areas of sympatry with steelhead may be restricted in some areas if native *O. clarki* trout are also in the basin. The generalized listing of basins and subbasins does not imply that these constitute single trout populations or that trout distribution is continuous throughout the areas listed. Detailed trout distribution is usually unknown and actual demographically independent trout populations have not been described. All current trout distributions are decreased from historical distributions. In particular many mainstem and lower basin tributary are no longer used but probably were historically. Many current trout populations are only in upper basins and are highly fragmented.

ESU	Category 1 Trout Populations (Sympatric)	Category 2 Trout Populations (Major Natural Barriers)	Category 3 Trout Populations (Major Artificial Barriers)
Upper Columbia River steelhead	Potentially all areas that are/were used by steelhead Wenatchee Lower Entiat Methow Okanogan	Upper Entiat Upper Kootenay Okanogan: Enloe Falls? Methow: Chewuch? Lost	Trout distributions currently more restricted than historically Okanogan Basin: Conconully Dam Enloe Dam? Chief Joseph Dam Lower Spokane to Post Falls Sanpoil Several small tributaries Lower Pend Oreille to Z-Canyon Columbia headwaters in Canada

B.2.2.3. New Hatchery Information

Hatchery considerations

Hatchery production averaged approximately 300,000 smolts/year in the 1960s, 425,000 in the 1970s, 790,000 in the 1980s, and more than 800,000 in the 1990s (including releases exceeding 1.0 million). Current mitigation/supplementation targets are to use locally obtained returning adults for programs. The objective for the Wenatchee is to release 400,000 smolts per year using broodstock collected from run-of-the-river fish in the Wenatchee River (main collection point is Dryden Dam). Broodstock collected at Wells Dam are used for outplanting in the Methow (380,000 target release), and the Okanogan (100,000 target release). The Entiat basin has been designated as a natural production 'reference' drainage—

no hatchery outplanting. Presently, there exist no monitoring programs in place to directly estimate natural production of steelhead in the Entiat. Categorizations of Upper Columbia River steelhead hatchery stocks (SSHAG 2003) can be found in Appendix B.5.3.

Table B.2.2.4. Hatchery releases of steelhead in the Upper Columbia River basin, organized by major steelhead production areas and broodstock of the release. Averages calculated by time period to facilitate comparison of release levels since the last BRT review with previous levels.

Basin	**Stock**	**Average releases per year**		
		1985 - 1989	**1990 - 1994**	**1995 - 2001**
Mainstem Columbia	Ringold	220,421	144,303	-
	Wells	27,757	26,204	202,269
	Skamania	-	35,130	70,523
	Wenatchee River	-	-	500
	Mainstem Total	177,270	146,883	273,292
Entiat	Wells	43,863	43,247	18,098
	Wenatchee River	-	-	12,465
	Entiat Total	43,863	43,247	30,564
Methow	Wells	439,926	428,894	418,227
Okanogan	Wells	133,198	123,972	119,996
Wenatchee	Leavenworth	62,376	95,631	23,960
	Ringold	113,225	-	-
	Wells	121,272	351,735	176,643
	Wenatchee River	81,072	-	106,554
	Wenatchee Total	377,945	447,366	307,158
ESU Total	All Stocks	1,243,110	1,249,116	1,149,239

B.2.3 MIDDLE COLUMBIA RIVER STEELHEAD

Primary contributor: Thomas Cooney
(Northwest Fisheries Science Center)

The Middle Columbia River Steelhead ESU includes steelhead populations in Oregon and Washington drainages upstream of the Hood and Wind river systems to and including the Yakima River. The Snake River is not included in this ESU. Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat river systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds. Most of the populations within this ESU are characterized by a balance between 1- and 2-year-old smolt outmigrants. Adults return after 1 or 2 years at sea.

Hatchery facilities are located in a number of drainages within the geographic area of this ESU, although there are also subbasins with little or no direct hatchery influence. The John Day River system, for example, has not been outplanted with hatchery steelhead. Similarly, hatchery production of steelhead in theYakima River system was relatively limited historically and has been phased out since the early 1990s. However, the Umatilla and the Deschutes river systems each have ongoing hatchery production programs based on locally derived broodstocks. Moreover, straying from out-of-basin production programs into the Deschutes River has been identified as a chronic occurrence. The Walla Walla River (three locations in Washington sections) historically received production releases of Lyons Ferry stock summer steelhead from the Lower Snake River Compensation Program (LSRCP). Mill Creek releases were halted after 1998 due to concerns associated with the then pending listing of Mid-Columbia River steelhead under the ESA. A new endemic broodstock is under development for the Touchet River release site (beginning with the 1999/2000 return year). Production levels at the Touchet and Walla Walla River release site have been reduced in recent years (WDFW comments to BRT).

Blockages have prevented access to sizable steelhead production areas in the Deschutes River and the White Salmon River. In the Deschutes River, Pelton Dam blocks access to upstream habitat historically used by steelhead. Conduit Dam, constructed in 1913, blocked access to all but 2-3 miles of habitat suitable for steelhead production in the Big White Salmon River (Rawding 2001). Substantial populations of resident trout exist in both areas.

B.2.3.1 Summary of Previous BRT Conclusions

The previous reviews (BRT 1998; BRT 1999) identified several concerns including relatively low spawning levels in those streams for which information was available, a preponderance of negative trends (10 out of 14), and the widespread presence of hatchery fish throughout the ESU. The 1999 BRT review specifically identified “...the serious declines in abundance in the John Day River Basin…” as a point of concern given that the John Day system had supported large populations of naturally spawning steelhead in the recent past. Concerns were also expressed about the low abundance of returns to the Yakima River system relative to historical levels "...with the majority of production coming from a single stream (Satus Creek)." The sharp decline in returns to the Deschutes River system was also identified as a concern.

The 1999 BRT review identified increases of stray steelhead into the Deschutes River as a "major source of concern." The review acknowledged that initial results from radio tagging studies indicated that a substantial proportion of steelhead entering the Deschutes migrated out of the system prior to spawning.

The previous BRT review identified a set of habitat problems affecting basins within this ESU. High summer and low winter temperatures are characteristic of production or migration reaches associated with populations within this ESU. Water withdrawals have seriously reduced flow levels in several Mid-Columbia drainages, including sections of the Yakima, Walla-Walla, Umatilla, and Deschutes rivers. Riparian vegetation and instream structure has been degraded in many areas—the previous BRT report states that "(O)f the stream segments inventoried within this ESU, riparian restoration is needed for between 37% and 84% of the river bank in various basins."

B.2.3.2 New Data and Updated Analyses

Abundance

With some exceptions, the recent 5-year average (geometric mean) abundance for natural steelhead within this ESU was higher than levels reported in the last status review (BRT 1999). Information on recent returns in comparison to return levels reported in previous status reviews is summarized in Table B.2.3.1 and depicted in Figures B.2.3.1-B.2.3.10. Returns to the Yakima River, the Deschutes River, and to sections of the John Day River system were up substantially in comparison to 1992-1997. Yakima River returns are still substantially below interim target levels and estimated historical return levels, with the majority of spawning occurring in one tributary, Satus Creek (Berg 2001). The recent 5-year geometric mean return of the natural-origin component of the Deschutes River run has exceeded interim target levels. Recent 5-year geometric mean annual returns to the John Day basin are generally below the corresponding mean returns reported in the previous status reviews. However, each of the major production areas in the John Day system has shown upward trends since the 1999 return year.

Recent year (1999-2001) redds-per-mile estimates of winter steelhead escapement in Fifteen Mile Creek were also up substantially relative to the annual levels in the early 1990s. Returns to the Touchet River are lower that the previous 5-year average. Trend or count information for the Klickitat River winter steelhead run are not available but current return levels are believed to be below interim target level.

Productivity

Short-term trends in major production areas were positive for seven of the 12 areas (Table B.2.3.1). The median annual rate of change in abundance since 1990 was +2.5%, individual trend estimates ranged from -7.9% to +11%. The same basic pattern was reflected in λ estimates for the production areas. The median short-term (1990-2001) annual

Table B.2.3.1. Summary of recent 5-year average (geometric mean) population abundance and trend estimates in comparison to estimates included in previous BRT review (BRT 1999). Estimates from previous status reviews in brackets. NR = no releases.

Population	5-year mean % natural origin[+]	Recent 5-year geometric mean			Short-term Trend (%/yr)		Interim Target	Current vs. Target
		Total	Natural					
		Mean (Range)	Current	Previous	Current	Previous		
Klickitat River	?	155 Redds (97 – 261)			+14.6	-9.2	3,600 sum+win	below target
Yakima River *	97 [95]	1,801 (1,058– 4,061)	1,747	800	+10.0	+14.0	8,900	20%
Fifteenmile Creek *	100 [100?]	2.87 RPM (1.3 – 6.0)			+7.8	-5.4	900	
Deschutes River	38 [50]	13,455 (10026– 21457)	5,113	3,000	+11.2	+2.6	5,400	95%
John Day Upper Mainstem	96 [100]	2,122 (926 – 4,168)	2,037		-1.7	-15.2	2,000	102%
John Day Lower Mainstem	NR	1.40 RPM (0.0-5.4)			-2.5	-15.9	3,200	
John Day Upper N. Fork	NR	2.57 RPM (1.6-5.0)			+9.6	-11.8	2,700	
John Day Lower N. Fork	NR	3.52 RPM (1.5-8.8)			+11.0	-1.2		
John Day Middle Fork	NR	3.70 RPM (1.7-6.2)			-2.7	-13.7	2,700	
John Day S. Fork	NR	2.52 RPM (0.9-8.2)			-0.8	-7.4	600	
Umatilla River	60 [76]	2,486 (1,480– 5,157)	1,492	1,096	+8.6	+0.7	2,300	65%
Touchet R. **	84 [93]	345 (273 – 527)	289	300	-0.5	-2.7	900	32%

* 5-year geometric mean calculated using years 1997–2001
** 5-year geometric mean calculated using only years 1998–2001

Table B.2.3.2 Middle Columbia River Steelhead population growth rate analysis. Summary of available trend data sets, results of calculating annual population growth rates (λ: geomean, probability geomean less than 1.0) Long-term = the length of the available data series, Short term = 1990 -2001 or most recent year. Population growth rates calculated for two hatchery effectiveness (HF) assumptions; HF = 0.0 hatchery fish available to spawn do not contribute to natural production, HF = 1.0 hatchery returns available to spawn contribute to broodyear natural production at the same rate as natural-origin spawners. Methods: DC – Dam counts; RC – redd counts; RPM – redds per mile index; TLC – estimated total live fish on spawning grounds.

	Series Length		Proportion Wild			Geometric Lambda (Mean, Prob. <1.0)				
Mid-Columbia Steelhead		**Measure**	**1987-96**	**Last 5 yrs**	**Hatchery Effectiveness Assumption**	**Recent**	**Long Term**		**Short Term**	
Yakima River Aggregate	1981-2000	DC		0.942	***HF =0.0***	**901**	**1.009**	0.456	**1.002**	0.49
					HF=1.0					
Klickitat River	1990-92,96-01	RC	na	na						
Deschutes River	1978-2002	DC	0.4	0.38	***HF =0.0***	**5566**	**1.022**	0.35	**1.076**	0.276
					HF=1.0		**0.84**	0.999	**0.816**	0.964
Warm Springs (above weir)	1980-1999		1	1			**0.942**	0.852	**0.904**	0.792
			1							
John Day R. Upper Mainstem	1974-2002	Exp. RC	0.986	0.963	***HF =0.0***	**2256**	**0.975**	0.699	**0.963**	0.672
					HF=1.0		**0.966**	0.817	**0.935**	0.789
John Day R. Lower Mainstem	1965-2001	Exp. RC		1			**0.981**	0.85	**1.010**	0.463
John Day R. Upper North Fork	1977-2002	Exp. RC		1			**1.011**	0.412	**1.077**	0.132
John Day R. Lower North Fork	1976-2002	Exp. RC		1			**1.013**	0.43	**1.174**	0.026
John Day R. Middle Fork	1974-2002	Exp. RC		1			**0.966**	0.743	**0.954**	0.655
John Day R. South Fork	1974-2002	Exp. RC		1			**0.967**	0.739	**1.011**	0.459
Umatilla River	1966-2002	DC	0.758	0.674	***HF =0.0***	**1658**	**1.007**	0.399	**1.070**	0.135
					HF=1.0		**0.969**	0.854	**0.947**	0.82
Walla Walla: Touchet River	1987-2001	DC	0.911	0.842	***HF =0.0***	**290**	**0.961**	0.769	**0.984**	0.676
					HF=1.0		**0.939**	0.74	**0.959**	0.666
Walla Walla: Main fork	1993-2000	DC		Data series too short to calculate trends						
Fifteen Mile Cr. (Winter Run)	1966-2001	RPM	na	na		3.48	**0.981**	0.635	**1.129**	0.064

population growth rate estimate was 1.045, assuming that hatchery fish on the spawning grounds did not contribute to natural production, with eight of the 12 indicator trends having a positive growth rate. Assuming that potential hatchery spawners contributed at the same rate as natural-origin spawners resulted in lower estimates of population growth rates. The median short-term λ under the assumption of equal hatchery/natural-origin spawner effectiveness was .967, with six of the 12 indicator trends exhibiting positive growth rates.

Long-term trend estimates were also calculated using the entire length of the data series available for each production area (Table B.2.3.1). The median estimate of long-term trend over the 12 indicator data sets was -2.1% per year (-6.9 to +2.9), with 11 of the 12 being negative. Long-term annual population growth rates (λ) were also negative (Table B.2.3.1). The median long-term λ was .98 under the assumption that hatchery spawners do not contribute to production, and .97 under the assumption that both hatchery and natural-origin spawners contribute equally. These longer trends are consistent with another recent analysis (McClure et al. 2003) of 28 index areas in the Middle-Columbia steelhead ESU over the 1980-2000 time period. In this analysis, the average population growth rate across all streams was 0.96, with only two of the 28 index areas showing a positive trend. [Note that the analyses in McClure et al. 2003 bracket those in the 2000 FCRPS Biological Opinion, which used slightly different assumptions about hatchery fish spawning effectiveness.]

All of the production area trends available for this ESU indicate relatively low escapement levels in the 1990s. For some of the data sets, earlier annual escapements were relatively high compared to the stream miles available for spawning and rearing. In those cases, it is reasonable to assume that subsequent production may have been influenced by density-dependent effects. In addition, there is evidence of large fluctuations in marine survival for Columbia River and Oregon coastal steelhead stocks (Cooney 2000, Chilcote 2001). Spawner return data sets for Mid-Columbia production areas are of relatively short duration. As a result of these considerations, projections based on simple population growth rate trends or on stock recruit relationships derived by fitting recent year spawner return data should be interpreted with caution.

Resident *O. mykiss* considerations

This section summarizes available information on resident *O. mykiss* populations within the ESU. Table B.2.3.3 and Appendix B.5.1 provide a broad overview of the distribution of Case 1, 2, and 3 resident populations within the ESU. See the section on Resident Fish in the Introduction section to the main body of this report for an explanation of the three cases and their relevance to ESU determinations. The section on Resident Fish in section B.1 of this steelhead report discusses how resident fish are considered in risk analyses.

Resident *O. mykiss* are sympatric with current and historical anadromous steelhead distribution throughout the Middle Columbia Steelhead ESU (Kostow 2003). Pelton/Round Butte Dam in the Deschutes River system and Condit Dam in the White

Salmon River are the major anadromous blockages within tributaries in this ESU. Irrigation diversions in other tributaries including the Umatilla and Yakima Rivers result in partial blockages or reduce the survival of migrating steelhead.

Lower reaches of most major tributaries in this ESU have been heavily affected by decades of agricultural impacts. The Deschutes River is an exception; its lower tributaries are relatively intact with strong flows of cold water. The resident *O. mykiss* population in the lower Deschutes River is highly productive, supporting some of the largest and most fecund trout in the entire Columbia Basin (Kostow 2003).

Tributaries and mainstem reaches in the upper portions of the Umatilla River, Walla Walla River and the Klickitat River are all relatively intact and support both steelhead and resident O. mykiss populations although there are no specific estimates of abundance for the resident form (Kostow 2003).

Resident *O. mykiss* production varies widely among the tributaries of the relatively large Yakima River system. Access by returning anadromous migrants to the Upper Yakima River drainage was effectively cut off for 18 years by Roza Dam. That area is believed to have been the most productive historical habitat for steelhead. Resident *O. mykiss* currently dominate production above Rosa Dam. Two lower Yakima tributaries, Satus Creek and Toppenish Creek, support most of the current steelhead production from the basin. The absence of 2+ smolts in these tributaries indicates little or no resident production. Steelhead and resident trout are present in the Naches River subbasin.

The John Day River system may have historically supported large populations of resident trout; their redds have been observed during steelhead redd surveys in this system (Kostow 2003). Some proportion of the age 0/age 1 fish counted during juvenile transects may be resident trout, although these redds are not systematically counted.

The mainstem Umatilla River has been heavily impacted by water withdrawals and other agricultural activities. However, headwater reaches are generally intact and have the capacity to support fairly large anadromous and resident *O. mykiss* juvenile production. Abundance estimates of juvenile *O. mykiss* from the upper Umatilla mainstem and tributaries show a high percentage of age 0 and 1 juveniles, while those 2+ and older make up a relatively small proportion of the juvenile sampled. Kostow (2003) concluded that resident adults may still outnumber returning steelhead in the basin.

Studies of relative spawning distributions and timing for steelhead and sympatric resident *O. mykiss* populations have been conducted on the upper Yakima River (Pearsons et al. (1998) and the Deschutes River (Zimmerman and Reeves, 2000). Pearsons et al (1998) concluded that there were substantial overlaps in spawning timing and distribution in the upper Yakima River, with steelhead spawning distributions generally nested within those of resident *O. mykiss*. The Deschutes River study indicated less overlap because of differences in microhabitat use by the two forms. In a previous study Zimmerman and Reeves (1996) did document trout and steelhead pairing late in the steelhead spawning period. Kostow (2003) reports observations of possible steelhead resident pairings during spawning on the John Day, Klickitat, Walla-Walla and Umatilla Rivers.

Table B.2.3.3: Distribution of *O. mykiss* trout by category relative to the Middle Columbia steelhead ESU. Only major barriers are noted; numerous small barriers, both natural and artificial, also exist. Many other natural barriers are present but have *O. clarki* trout, rather than *O. mykiss* trout, above them. *O. mykiss* trout distribution in areas of sympatry with steelhead may be restricted in some areas if native *O. clarki* trout are also in the basin. The generalized listing of basins and subbasins does not imply that these constitute single trout populations or that trout distribution is continuous throughout the areas listed. Detailed trout distribution is usually unknown and actual demographically independent trout populations have not been described. All current trout distributions are decreased from historical distributions. In particular many mainstem and lower basin tributary are no longer used but probably were historically. Many current trout populations are only in upper basins and are highly fragmented.

ESU	**Category 1 Trout Populations (Sympatric)**	**Category 2 Trout Populations (Major Natural Barriers)**	**Category 3 Trout Populations (Major Artificial Barriers)**
Middle Columbia Steelhead	Historically all areas where steelhead are/were present. Trout distributions currently more restricted. Fifteenmile Eightmile Deschutes Klickitat Umatilla: Upper Umatilla John Day: Upper tributaries Walla Walla Upper tributaries Yakima: Upper Yakima Naches Some other small tributaries	All natural barriers upstream of Klickitat and Deschutes Basins: Deschutes: White River Upper Deschutes (Big Falls) Upper NFk Crooked R. John Day: Upper SFk. John Day	Trout distributions currently more restricted than historically Little White Salmon (Conduit Dam) Deschutes (Pelton/Round Butte dams) Metolius Squaw Cr. Crooked River Umatilla (Irrigation dams) Willow Cr. Butter Cr. McKay Cr.

Zimmerman and Reeves (2000) used otolith microchemistry to compare samples of returning adult steelhead to samples taken from resident trout. They concluded that the anadromous steelhead sampled had anadromous mothers and that the resident trout sampled had resident mothers. The study was unable to determine the corresponding contributions of anadromous and resident males to anadromous and resident progeny.

In the Klickitat River basin, a sample of presumed resident fish from above Castille Falls appears to be of native origin (rather than introduced rainbow trout), based on genetic analyses conducted by WDFW (S. Phelps, unpublished data). However, this is a Case 2 population (above a natural barrier) and is also differentiated from anadromous populations within the ESU. Currens (1997) found genetic evidence for substantial isolation between resident fish in Eightmile Creek (a tributary of Fifteenmile Creek) and anadromous fish within the ESU. This is believed to be a Case 1 population—historical contact with anadromous fish and no apparent barrier to migration at present. The genetic profile for the resident fish is consistent with it being a native redband population rather than introduced rainbow trout.

Currens (1997) genetically compared Case 3 resident *O. mykiss* above artificial barriers in McKay Creek and Butter Creek (both tributaries of the Umatilla River) with samples from Umatilla River steelhead. Considerable variation was found among all samples, but the samples from McKay Creek were particularly distinctive. Currens speculated that the McKay Creek population may have been introgressed with non-native hatchery rainbow trout, which have been stocked in the area.

In the Deschutes River basin, Currens et al. (1990) found genetic differences between *O. mykiss* populations from upper and lower Nena Creek and East Fork Foley Creek that were of the same magnitude as differences among different steelhead populations within the basin. The upper and lower reaches of these creeks are separated by natural waterfalls that may or may not serve as barriers to anadromous fish (hence, it is uncertain whether these are Case 1 or Case 3 populations). White River falls is an ancient barrier, and Case 2 resident fish above the falls are genetically quite distinctive (Currens et al. 1990).

In the John Day River, Currens et al. (1987) found that genetic differences between *O. mykiss* from the North and South Forks were larger than differences between presumed steelhead and (Case 1) rainbow trout in the South Fork. Genetic analysis of Yakima River *O. mykiss* (Pearsons et al. 1998) found no significant differences between sympatric resident (Case 1) and anadromous fish, a finding that is consistent with observations of interbreeding between the two forms.

B.2.3.5. New Hatchery Information

Relatively high numbers of hatchery-origin steelhead returning from releases outside of the Deschutes River system continue to enter the Deschutes system. The actual number of out-of-basin-origin hatchery fish that spawn naturally in the Deschutes is not known. Preliminary results from recent radio tracking studies cited in Cramer et al. (2002)

backs up the hypothesis that a significant proportion of hatchery strays entering the Deschutes River are ‘dip-ins,’ fish that migrate out of the system prior to spawning. The estimated escapements to the spawning grounds used in the status review updates already include an adjustment to reflect out-migrating stray hatchery fish. The estimates of spawning escapement into the Deschutes River system depicted in Figure B.2.3.2 assumed that 50% of the estimated number of outside hatchery fish passing over Sherars Falls dropped back down and did not contribute to spawning in the Deschutes River system (Chilcote 2002 spreadsheet analysis). Cramer et al. (2002) identified two other sets of information regarding the potential contribution of hatchery stocks to natural spawning in the Deschutes River. ODFW spawner surveys in Buckhollow, Bakeoven, and Trout creeks indicate a relatively high proportion of wild fish in those major spawning tributaries in recent years, in comparison to the estimated fraction of wild over Sherars Falls (below major mainstem spawning areas). In addition, estimated natural-origin returns to the mainstem/lower tributary roughly track the returns to the Warm Springs River in time, in spite of large differences in estimated hatchery contributions in some years. Additional information is needed to clarify the potential impact of outside hatchery-origin fish to natural production in the system. Categorizations of Middle Columbia River steelhead hatchery stocks (SSHAG 2003) can be found in Appendix B.5.3.

Table B.2.3.4. Steelhead hatchery releases in Middle Columbia River region by major steelhead production areas and release broodstock release. Averages calculated by time period to facilitate comparison of release levels since the last BRT review with previous levels.

Basin	Race	Stock	Average releases per year 1985 - 1989	1990 - 1994	1995 - 2001
Mainstem Columbia	Summer	Unknown	4,523	-	-
	Summer	Dworshak B	-	5,440	412
		Mainstem Total	4,523	5,440	412
White Salmon	Summer	Skamania	9,798	18,238	8,641
	Winter	Skamania	12,414	32,615	17,497
	Winter	Elochoman River	-	-	6,428
	Winter	Kalama River	-	-	3,669
	Winter	Beaver Creek	-	-	5,741
		White Salmon Total	22,212	50, 854	41,976
Little White Salmon	Summer	Skamania	0	0	15,395
Klickitat	Summer	Skamania	87,821	96,704	113,616
Deschutes	Summer	Deschutes River	209,443	163,505	168,680
Rock	Winter	Skamania	1,428	5,176	4,083
	Winter	Elochoman River	-	-	1,560
		Rock Creek Total	1,428	5,176	5,644
Umatilla	Summer	Umatilla River	66,730	130,958	142,259
Walla Walla	Summer	Lyons Ferry	191,854	208,632	293,256
	Summer	Wells	116,396	-	-
	Summer	Ringold	-	55,752	-
	Summer	Touchet River	-	-	5,212
		Walla Walla Total	308,251	264,385	298,469
Yakima	Summer	Ringold	21,726	-	-
	Summer	Wells	18,201	-	-
	Summer	Yakima River	112,641	72,039	-
		Yakima Total	152,569	72,039	0
ESU Total		All Stocks	852,978	789,063	786,451

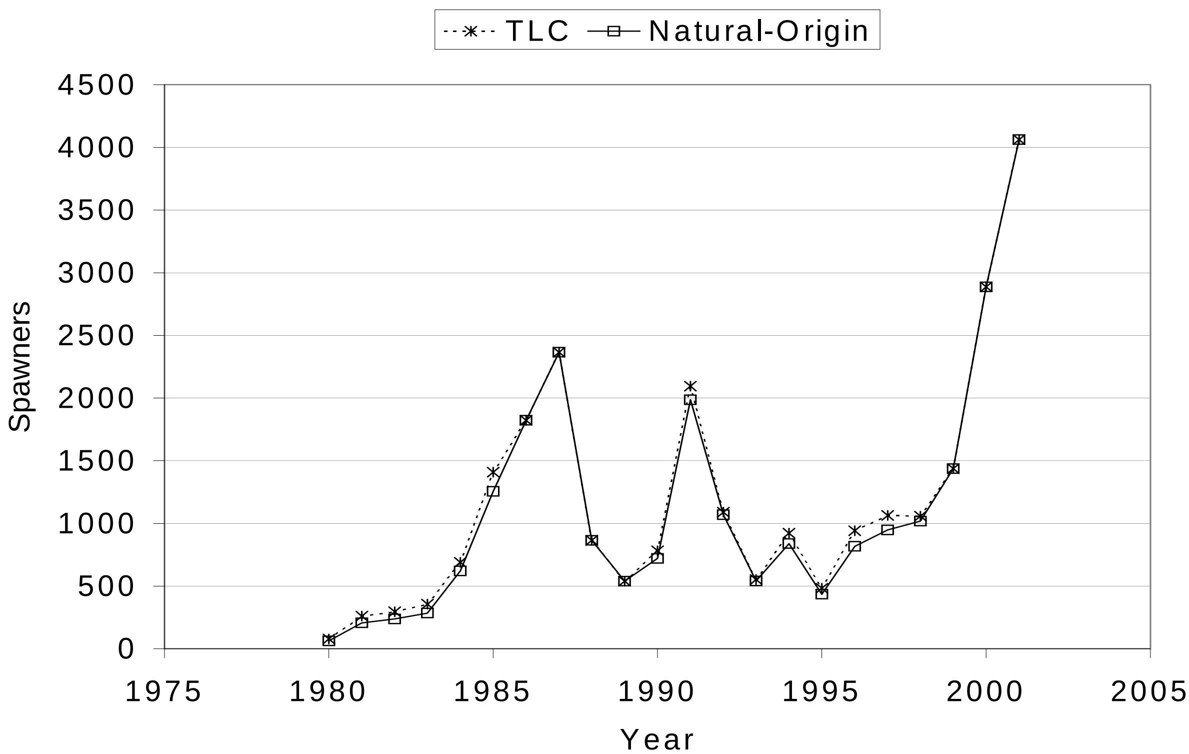

Figure B.2.3.1. Yakima River steelhead spawning escapment estimates. From WDFW database. Based on Prosser Dam count.

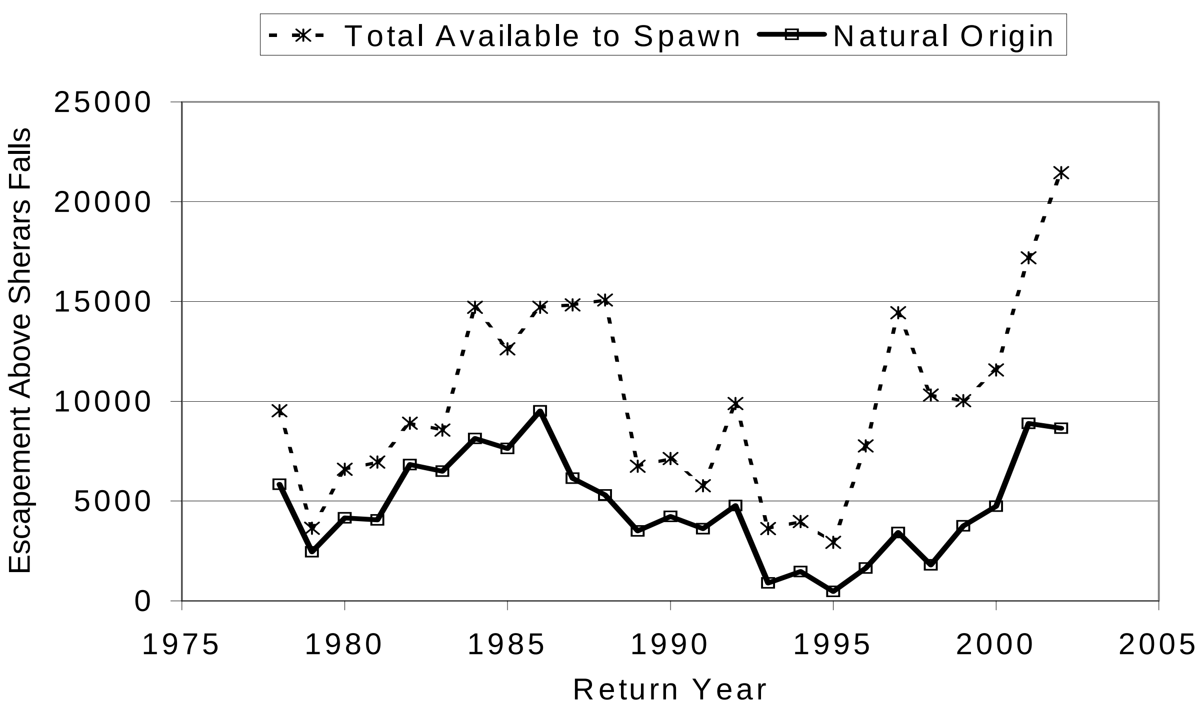

Figure B.2.3.2. Deschutes River steelhead escapement estimates over Sherars Falls. Run size estimates based on ODFW mark/recapture analysis. Hatchery/Wild ratios based on returns to Pelton Ladder and Warm Springs NFH (see Chilcote 2001, 2002).

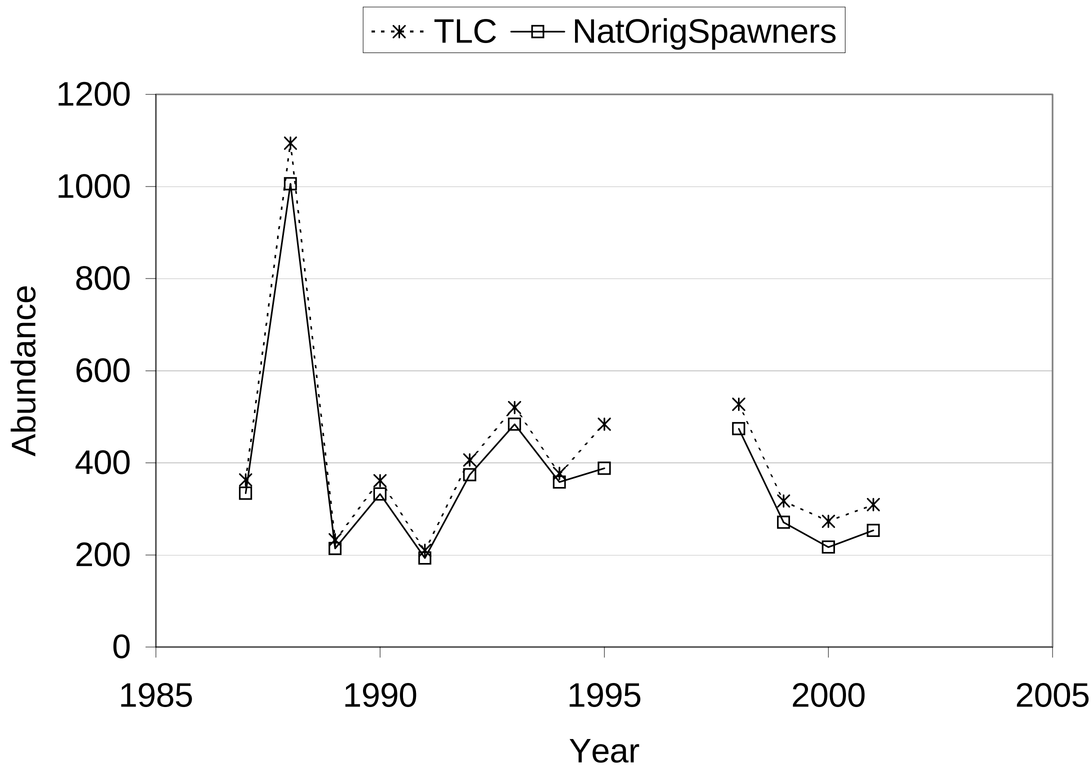

Figure B.2.3.3. Touchet River steelhead escapement estimates. Estimates based on spawning ground surveys upstream of Dayton, WA (James & Scheeler 2001).

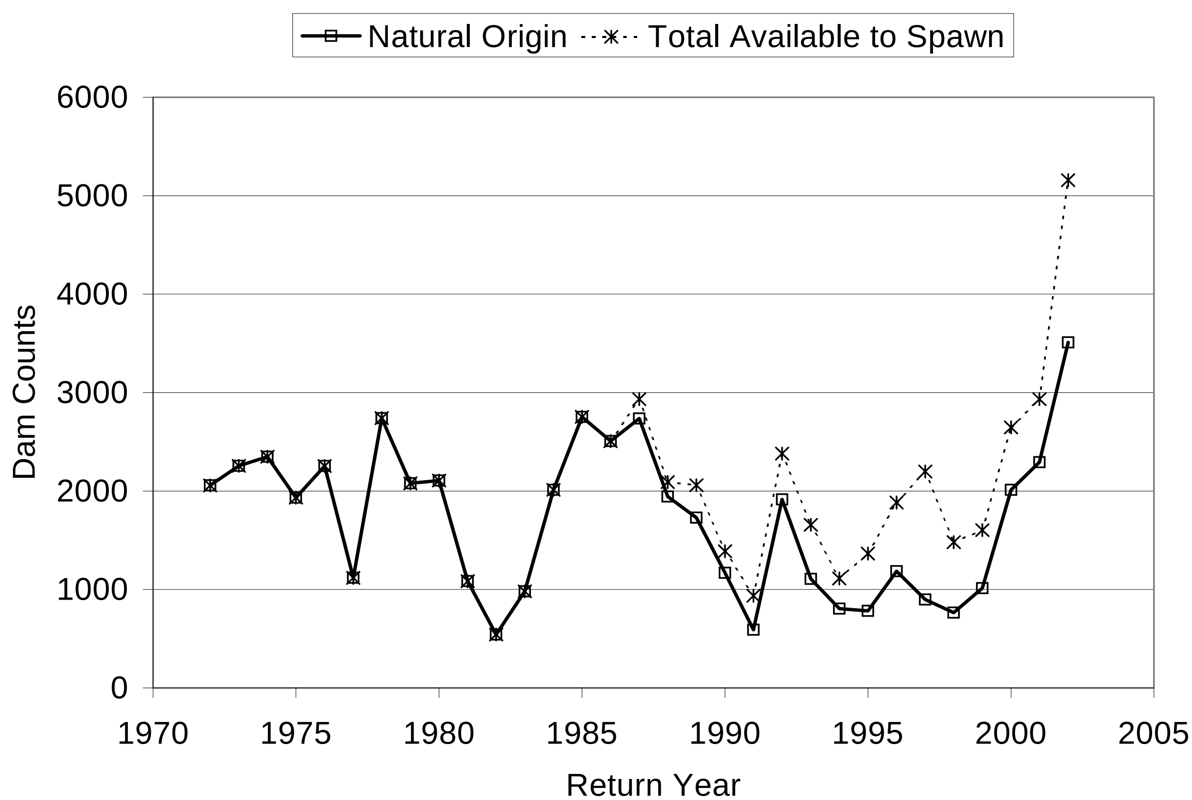

Figure B.2.3.4. Umatilla River steelhead counts at Three Mile Dam (Chilcote 2001).

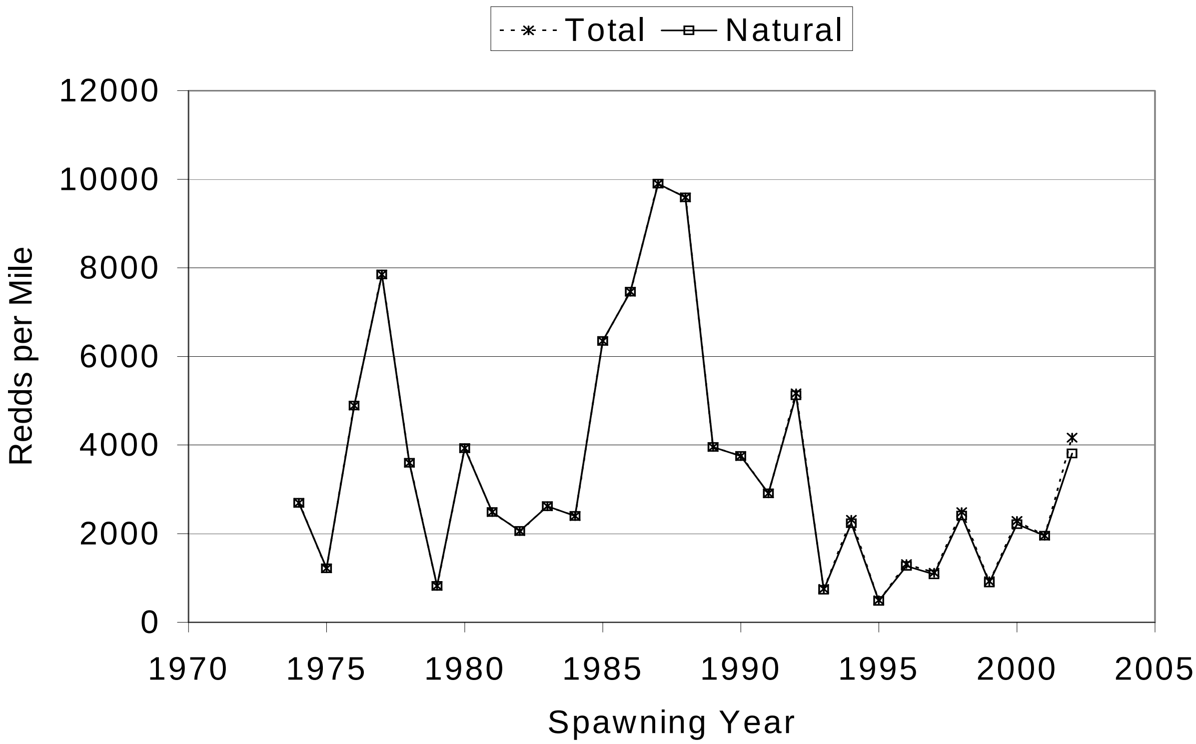

Figure B.2.3.5. Upper John Day steelhead estimates expanded from annual redd counts (Chilcote 2002).

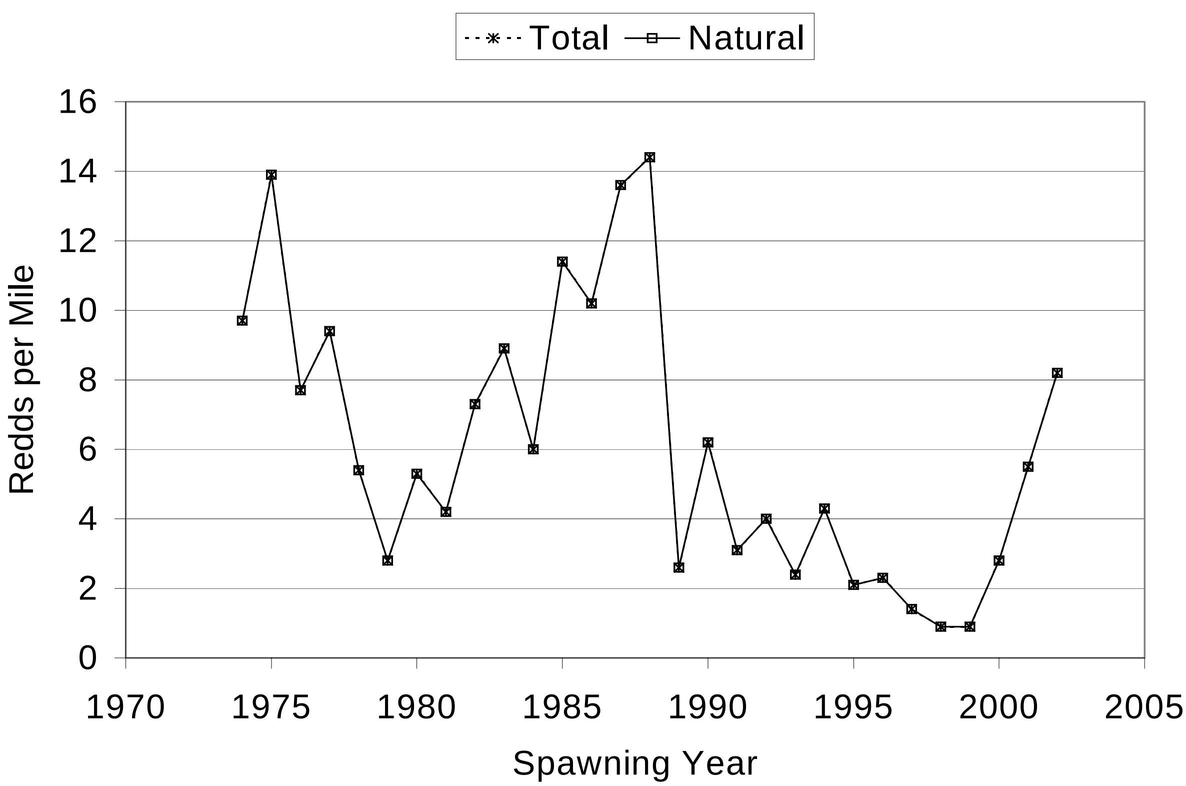

Figure B.2.3.6. South Fork John Day steelhead redds per mile from index areas (Chilcote 2001).

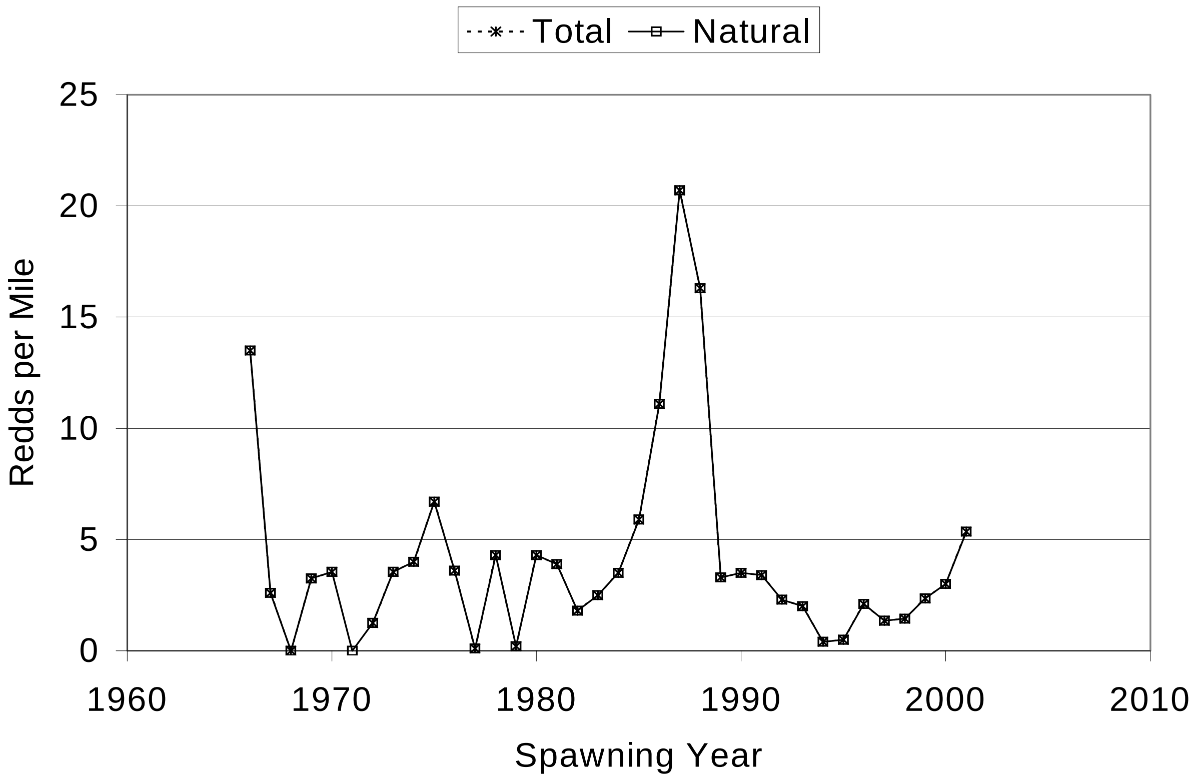

Figure B.2.3.7. Lower Mainstem John Day steelhead redds per mile from index areas (Chilcote 2001).

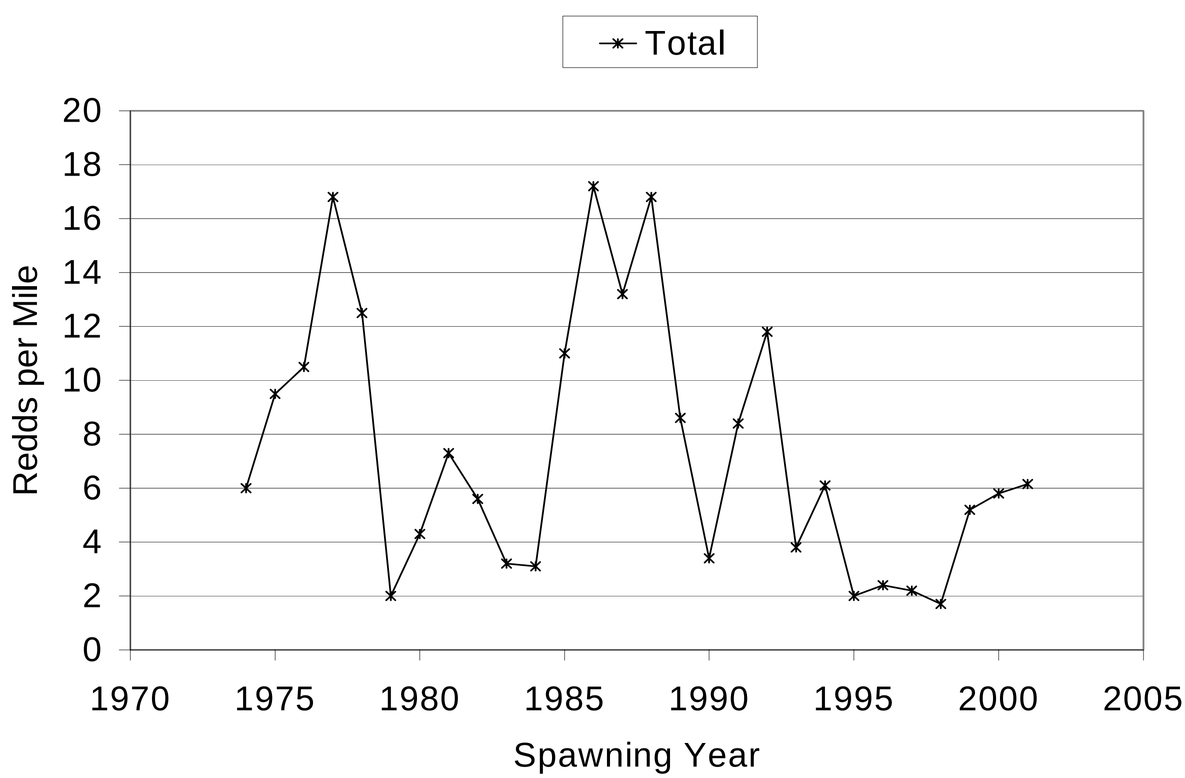

Figure B.2.3.8. Middle Fork John Day steelhead redds per mile from index areas (Chilcote 2001).

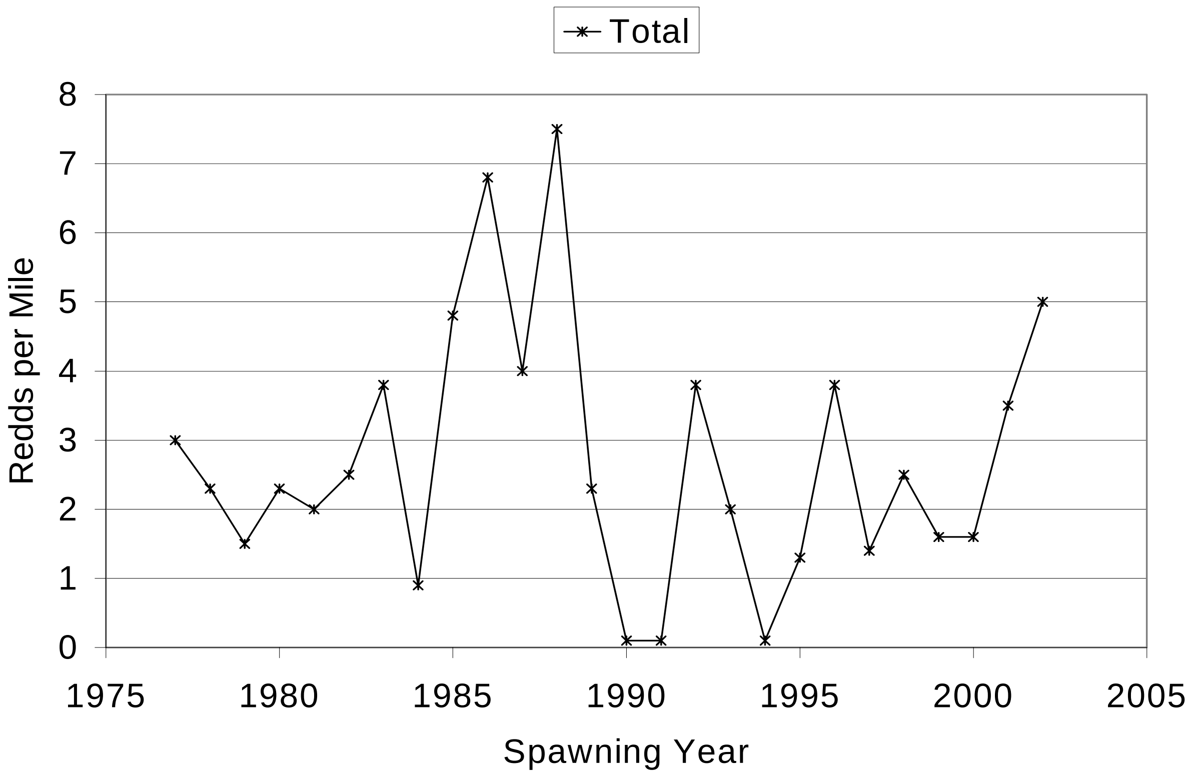

Figure B.2.3.9. Upper North Fork John Day steelhead redds per mile from index areas (Chilcote 2001).

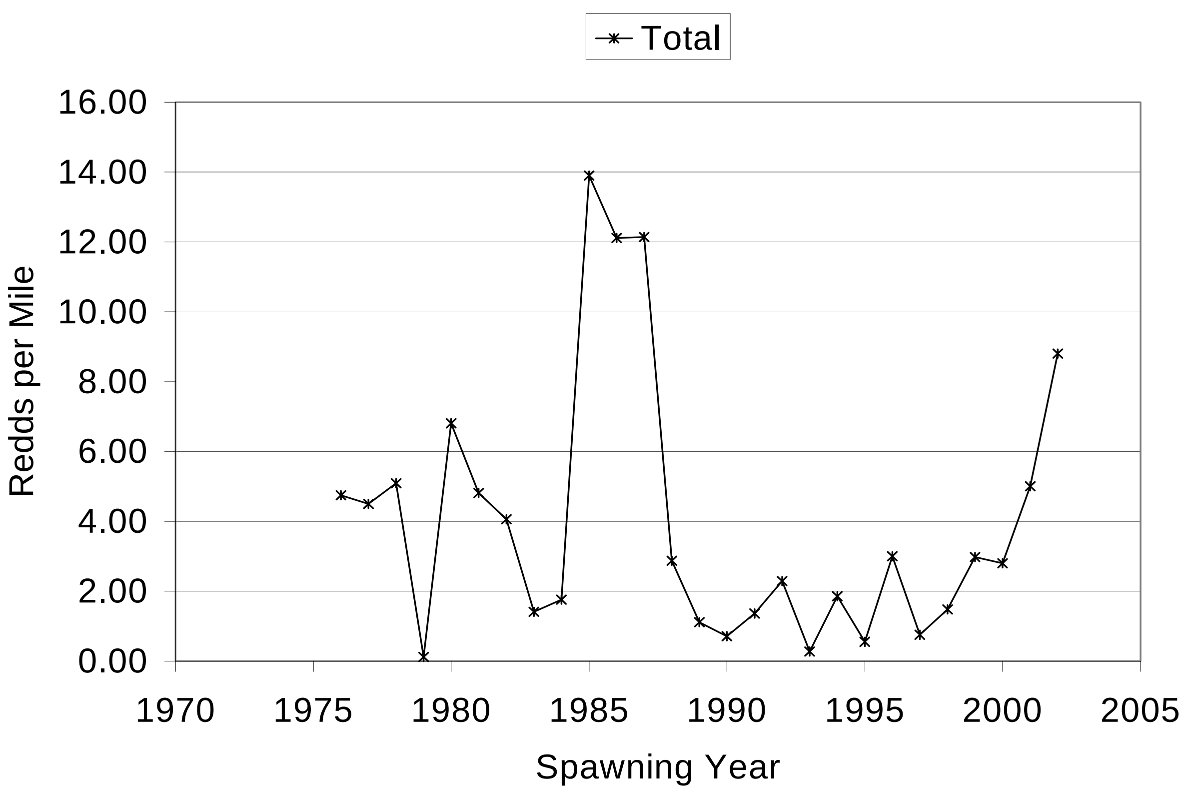

Figure B.2.3.10. Lower North Fork John Day steelhead redds per mile from index areas (Chilcote 2001).